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The Editorial Board will greatly appreciate offers from readers to do abstracting from selected periodicals published in foreign languages.

Those having a reading knowledge of any one or more of same will oblige if they will communicate with the Editor.

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British Journal of Anæsthesia

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FOREWORD.

WITH this Number, the "British Journal of Anæsthesia" makes its debut as a publication devoted entirely to the interests of Anæsthesia and its practitioners. That there is need for a Journal of its character is amply demonstrated by the hearty support received in many quarters, and it thus, optimistically, takes its place amongst those special Medical periodicals which are representative of a particular branch of Medicine or Surgery.

As regards the future it should be stated that it is hoped to be able to keep abreast of the times in all that appertains to Anæsthesia, and to reflect the progress our Speciality is making everywhere.

In a word, the "British Journal of Anæsthesia" anticipates acting not only as the mouthpiece for those who desire to give public expression to the results of their research and experience, but to place before its readers an account of what is being done generally in the anæsthetic world.

Thanks to the confidence vouchsafed by the Guarantors, and to the encouraging support of our advertisers, the financial arrangements for the first year are assured. The Journal is thus happily launched upon its journey with hopefulness and good cheer.

To make the Journal of the greatest value to its readers, each Number should contain a summary of contemporary thought and achievement. To accomplish this end it has been decided to include, in addition to short Editorials, as broad a variety of original articles as possible.

In this Number we are especially fortunate in having the Historical Aspect of Anæsthesia discussed by Sir D'Arcy Power. It is obviously desirable to learn the views of those across the Atlantic, and we are privileged to include as a contributor Dr. James T. Gwathmey, of New York, the Founder and First President of the American Association of Anæsthetists, which now has a membership of 1,200. The Bibliography of Current Anæsthetic Literature and Programmes of Foreign Societies are intended to place before our readers the trend of the latest research and thought of the day.

* * * * *

The question of organization for the general body of Anæsthetists must sooner or later present itself in a concrete form. There is always the possibility of finding ourselves in a position where it becomes necessary to exert an influence commensurate with our numbers, and to attempt to do so, except as a united entity, would more than likely meet with failure.

If there is strength in unity there is surely futility in the reverse.

At a recent meeting of the Anæsthetic Section of the Royal Society of Medicine, the matter of Coroners' Inquests in relation to all anæsthetic fatalities was discussed. There was manifest a marked difference of opinion as to the necessity of these public examinations following every ordinary case, and it was made evident that there is ample room for reform.

Questions of this nature, and others, could be influenced to a great extent by a united organization. Placing aside purely legal matters, the scientific, educational and economic aspects of the Practice of Anæsthesia demand discussions which are only possible in assemblies of those especially interested in that branch of Surgery.

With the exceptions of the Section in London and the Society in Scotland, the great majority of the something like 500 Practitioners of Anæsthesia have no affiliations with similar bodies.

A suggestion to be considered in this connection is the formation of a Midland Society to comprise the Anæsthetists of Birmingham, Bristol, Derby, Leicester and Cardiff; a

North of England Society to consist of Manchester, Liverpool, Leeds and Sheffield; and others according to geographical divisions.

These, with London and Scotland, and, ultimately, the Dominions, Colonies and Dependencies, should form the basis of a general organization, viz., the British Association of Anæsthetists.

This may, no doubt, be regarded as a somewhat ambitious programme, but, in truth, it only parallels similar activities elsewhere.

Such organisations as the Ophthalmological Society, the Pathological Society, the Psycho-Neurological Society, and the Oto-Laryngological Society are examples of successful, country-wide associations of specialists; yet probably not one of these has a greater field to draw from than the grand total of anæsthetists in the same area.

It is a self-evident fact that anæsthetists united in one large, virile body can do much to advance the science and practice of anæsthesia, and it behoves those of us who are alive to the *possibilities* of unity to give the matter attention and thought.

THE EDITOR.

EARLY ANÆSTHESIA.

By Sir D'Arcy Power, K.B.E., F.R.C.S. (Eng.),
Past President of the Section of the History of Medicine of the Royal Society of Medicine.

IT is fitting that the "British Journal of Anæsthesia" should contain some reference to the earlier means of causing insensibility to pain although the history of anæsthesia can never be properly elucidated. It is inextricably bound up with the problems of hypnosis, hysteria, charlatanism and the mentality of nations at different epochs which has not yet been the subject of study by competent scholars even for classical times. Opium, Indian Hemp and Alcohol were used from a very early period for the purpose of deadening pain, and they continued in use until the introduction of modern anæsthetics in 1846. But they were probably only employed in exceptional cases because even to our own time the avulsion of a toenail, the opening of an acute abscess of the breast, the incision of a whitlow and the removal of enlarged tonsils were not deemed worthy of an anæsthetic.

Nepenthe, the drug used by the Egyptians to alleviate pain, was probably opium or Indian hemp, and Indian hemp was certainly used both in Scythia and in China in the form of inhalation of the fumes to produce insensibility. Herodotus tells of the Massagetæ that "they light a fire, sit round in a circle and inhale the fumes of the burning fruit." Helen too in the Odyssey "cast a drug into the wine whereof they drank, a drug to lull all pain and anger and bring forgetfulness of every sorrow. Whoso should drink a draught thereof, when it is mingled in the bowl, on that day he would let no tear fall down his cheeks, not though his mother and his father died, not though men slew his brother or dear son with the sword before his face and his own eyes beheld it." The knowledge of these herbs, Homer says, she had learnt from Egypt, where "each man is a leech skilled beyond all human kind." Hoa-tho, who practised in China, is said to have given his patients a preparation of hemp when he operated upon the bones, stomach or intestines. After a few

moments the patient became as insensible as if he had been drunk or dead, and Hoa-tho then made openings and incisions, amputated and removed the disease, brought the tissues together with sutures and applied dressings. The patient recovered after a certain number of days without having experienced the slightest pain.

The Greeks also used Mandragora infused in wine. They called it *Morion,* and Lucius Appuleius (*circa* 400 A.D.) states that half an ounce would cause so deep a sleep for several hours that a limb could be amputated without pain. The Jewish women used to give a draught of Morion to those who were crucified, and this may have been the " wine and myrrh" offered to our Saviour on the Cross. Mandragora, too, was an important constituent of the " sleeping apple " mentioned by Dioscorides (*circa* 40—90 A.D.), the "Father of Pharmacy." It was made with opium, mandragora, the juice of the water hemlock, the seeds of henbane and musk, and caused sleep when it was repeatedly smelt.

Albertus Magnus (1193—1280 A.D.) distilled fire-water from red wine and common salt. He may thus have produced a mixture of ether and alcohol capable of producing anæsthesia by inhalation. A quintessence of several soporific herbs was also manufactured. It was so volatile that it had to be kept in leaden vessels well covered, and when the essence was inhaled it produced sleep without subsequent headache.

Theodoric (1205—1298 A.D.), Bishop of Cervia, gives the following directions for making " a soporific sponge " taught him, as he says, by his master Hugh of Lucca :—" Take of opium, of the juice of the unripe mulberry, of henbane, of the juice of hemlock, of the juice of the leaves of mandragora, of the juice of wood ivy, of the juice of the forest mulberry, of the seeds of lettuce, of the seeds of the dock which has round apples, and of the water hemlock, of each an ounce. Mix them all in a brazen vessel and then place a new sponge in it. Boil them all together for so long as the sun lasts in the dogdays and until the sponge absorbs all the liquid. Put it aside to dry and when it is required for use put the sponge in hot water for an hour and afterwards apply it to the face of the patient until he falls asleep. When the operation is finished soak another sponge in vinegar and let the patient

breathe through it, or drop the juice of fenugrek into his nostrils; he will quickly awaken."

The surgeons of the fourteenth century seem to have depended upon local as well as general anæsthesia. John Arderne (1307—1380 A.D.) recommends "an ointment with which if any man be anointed he shall suffer cutting in any part of his body without feeling or acheing. Take the juice of henbane, mandragora, hemlock, lettuce, black and white poppy and the seeds of all these aforesaid herbs, if they may be had, in equal quantities; of Theban poppies and of poppy meconium one or two drachms with sufficient lard. Braize them all together and thoroughly in a mortar and afterwards boil them well and let them cool. And if the ointment be not thick enough add a little white wax and then preserve it for use. And when you wish to use it anoint the forehead, the pulses, the temples, the armpits, the palms of the hands and the soles of the feet and immediately the patient will sleep so soundly that he will not feel any cutting. Also from one grain to half a drachm of Theban opium dissolved in a pint or more of wine, according to the strength of the patient, will make him that drinketh it sleep. Also the seed of white henbane given alone in wine makes the drinker sleep at once and so soundly that he will feel nothing that is done to him. And know that it is well to tweak the nose, to pinch the cheeks or to pluck the beard of such a sleeper to quicken his spirits lest he sleep too deeply. Do in this wise to a man that is thus sleeping:—Put to his nose grey bread that has been toasted and is moistened with strong vinegar; or put vinegar or mustard to his nostrils; or wash his head in strong vinegar; or anoint his temples with the juice of rhubarb; or give him some other sternutory and he will immediately wake up. And know that it is good to give him afterwards Castoreum, for Castoreum chafeth and most comforteth the chilled sinews (*i.e.*, nerves) and relieveth the paralysis. And also give him things that comfort the brain such as castor, musk, nutmegs, roses, nenufar, myrtle and sumac."

It seems clear from this extract that there was some systematic method of anæsthetising patients in England during the fourteenth century. John Arderne was an operating surgeon practising amongst the higher classes at

a time when chivalry was at its highest; his patients lived luxurious lives and probably felt pain as acutely as we do ourselves. They were also extremely credulous, and hysteria was common. A very slight degree of real anæsthesia, coupled with a profound belief in its efficacy, might therefore have been sufficient to obtain the results claimed by Arderne.

It was far different with their children and grandchildren. Constant wars and civil troubles toughened their moral fibre and rendered them callous to the sufferings of others and apparently to their own pain. Nothing is heard of any attempts at anæsthesia during the wars of the Roses or under the Tudors or Stuarts. The gentle surgeon had passed away and was replaced by a rough, honest type who looked upon pain, if he thought of it at all, as a divinely ordained consequence of his handiwork which it would be impious to alleviate. No attempt was made to minimise it for even so detailed a writer as Samuel Pepys looked back to what must, in his case, have been a prolonged lithotomy operation without any mention of unconsciousness. He was just tied up and cut for stone.

The revulsion came as much from the surgeon as the patient. We read of Cheselden (1688—1752) being sick at Guy's before his operations, and of Abernethy (1764—1831) vomiting at the thought of what he had to go through at every major operation.

As the science of chemistry advanced various tentative but fruitless attempts were made to produce anæsthesia. Pearson at Birmingham in 1785, Humphry Davy in 1799 at Bristol, Dr. Warren at Boston in 1805, Michael Faraday in London in 1818, and Christison in Edinburgh in 1836 were paving the way for anæsthesia by their experiments with sulphuric ether or with nitrous oxide, but it was not until 1844 that Horace Wells drew especial attention to the value of laughing gas in dentistry, nor until 1846 that Dr. Morton etherised a patient for Dr. J. C. Warren at the Massachusetts General Hospital. From that time onward the progress of anæsthesia was uninterrupted, passed rapidly through the necessary period of empiricism and soon entered upon the scientific stage which it is the endeavour of the present Journal to develop.

PAINLESS CHILDBIRTH BY SYNERGISTIC METHODS.*

A Preliminary Report.

By E. P. Donovan, M.D.,
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New York, N.Y.

MYTHOLOGICAL, profane and sacred literature abound in incident, fact and fancy, showing that from the dawn of history man has sought to assuage grief and pain by some means of dulling consciousness.

Both the Bible and Talmud contain references to the ancient practice of inducing sleep by artificial means. In these attempts many methods and diverse agents have been employed. The inhalation of fumes from various substances, weird incantations, the external and internal application of drugs and many strange concoctions, pressure upon important nerves and blood vessels, mesmerism, hypnotism, etc., have all played their part in the evolution of anæsthesia. But modern anæsthesia was not known to the world until after the successful public demonstration of ether by Morton in 1846.[1]

One of the first uses to which it was put was to modify the pains of childbirth. Sir J. Y. Simpson[2] of Edinburgh, was the first to use ether in obstetrical cases, but not entirely satisfied, sought a substitute, and to him we are indebted for the second most universally used agent for general anæsthesia—chloroform. Common sense prevailed over the opposition of clergy and laity of his day, "to avoid one part of the primeval curse on women," and chloroform and ether are now used almost universally for special cases and in certain stages of labour. However, where expense is not considered, nitrous oxide and oxygen have supplanted the use of these agents.

In 1880, Klikowitch[3] of St. Petersburg, recommended an

* Read before the Atlantic City Medical Society, Friday, May 11, 1923.

80 per cent. mixture of nitrous oxide and oxygen for obstetrical purposes, and this is about the admixture that is used to-day for analgesic purposes. Guedel of Indianapolis was one of the first to endorse strongly this combination in normal labour in the United States (1911), and it is now quite generally employed.

Spinal analgesia has been used with success—as have also local analgetics to the cervix, the perineum and the rectum, but these methods have but few followers to-day.

Schneiderlin, in 1899, recommended the use of morphin and scopolamin for surgical anæsthesia, but Steinbuchel first recommended its use in labour in 1902. Kronig and Gause of Freiburg are responsible for its introduction into the United States, reporting 3,000 cases in a paper read in Chicago in 1913. Kronig and Gauss use narcophin, a proprietary narcotin—morphin meconate. There is a good reason for using this combination, and those who do not have no right to condemn or criticise "twilight sleep." Sollman states (p. 260), "Narcotin has a considerable potentiating action on morphin. With hypodermic injection 5 mg. of morphin produced no measurable analgesic effect, with 10 mg. the analgesia was marked in two subjects, the third responded by hyperæsthesia. With narcotin 8 mg. was ineffective, 20 to 40 mg. produced first some hyperexcitability, then slight analgesia.

With a mixture of equal parts of morphin and narcotin containing 3—1/3 mg. the analgesia was almost as great as with 10 mg. of morphin alone. This combination was also effective on the subject who resisted morphin." (p. 267.) "Morphin probably tends to delay the progress of labour by its psychic sedative action, largely by preventing the reinforcement of labour pains by the contraction of the abdominal muscles."

This system has been in turn praised and condemned; to-day it is practically abandoned except by Kronig and Gauss and a few specially equipped sanataria. Sollman further states, "the use of scopolamin-morphin anæsthesia is justified (if at all) only in specially equipped institutions and not in private practice, or even in ordinary hospitals." It is applicable only in about 30 per cent. of labour cases.

All of the above agents and methods require either a specialized technique, unusual equipment or trained personnel. Numerous inquiries from many sources indicate that none of these methods are satisfactory to the majority of physicians.

The development of painless labour by synergistic methods was undertaken from a purely scientific and altruistic viewpoint. It was decided that the method should be so simple that it could be used either in the home or hospital, and by any physician, in an entirely empirical manner. The ideal sought was a state of relaxation and analgesia with consciousness but little if at all impaired, so that full co-operation might be had at all times. The methods by which this condition was to be obtained were outlined to the chief and attending obstetricians of the N.Y. Lying-in Hospital, Asa B. Davis and George W. Kosmak, and were as follows :—

(1) To start with a minimum dose at which time no definite results were expected and to gradually increase the dose until definite results were obtained.
(2) To stop at any time in the development of the technique if either mother or child appeared to be in danger.
(3) To publish the results whether favourable or unfavourable.

With this understanding work was commenced on the 10th of February. The first four cases showed practically 75 per cent. failure. To-day the first chapter of painless labour by synergistic methods is completed when we can secure over 75 per cent. success. By " success " is meant the amelioration of pain to such an extent that patients state that they were " helped "—only a few of the 75 per cent. had a comparatively painless labour. By " failure " is meant whenever the patient obtained no relief from the method. At no time was the mother's condition imperilled in the slightest degree. Only in one instance did the infant seem to be affected. Whether or not this was from the medication cannot be stated positively, but it seemingly was. In the first series of drugs used there was not only failure but delay. This delay was in a measure corrected by placing 10 grains of quinine hydrochloride in the mixture. Sollman states that " satisfactory

results have been reported from its use in all stages of labour. This drug stimulates the contractions and increases the tone of the uterus."[4] Since this addition in only one or two cases has there been any delay, and in these exceptional cases exhausted nature was more powerful than the drug.

There also seemed at one time to be an increase in the nausea and vomiting. This was corrected in a very great measure by eliminating urethan and paraldehyde, thus also making the final mixture simpler. The other drugs considered fundamental to the scheme are magnesium sulphate, urea, ether and morphin. Two to four drachms of the magnesium salts is the maximum dose used in our investigations of painless labour, although the writer has used two ounces of the salts per rectum in other cases without deleterious effect. The magnesium sulphate must be chemically pure (the usual commercial product may cost fivepence per pound, the chemically pure four shillings per pound).

Weston and Howard[5] have injected 2 cc. or more of a 50 per cent. solution of magnesium sulphate subcutaneously or intramuscularly more than a thousand times with no local pain or sloughing. They state the sedative action occurs in 15 to 30 minutes and lasts from five to seven hours, and is found to be a very good substitute for morphin and hyoscin. In a few instances the patient became quiet but did not sleep. In 82.7 per cent. it was effective. In 6 per cent. the dose was repeated before sedation occurred. In 11 per cent. no effect even after three or more doses.

Rector[6] has used magnesium sulphate colonically in doses of two drachms in over 300 cases. The Presbyterian Hospital used the salts over 200 times by hypodermoclysis in four drachm doses with good results. In both instances other drugs or agents were added to complete the analgesia or anæsthesia.

Magnesium sulphate used in two to four drachm doses by rectum leaves a margin of safety amply sufficient to satisfy the most critical and is, next to urea, probably the safest drug in the combination.

In a personal communication, Alma J. Neill, Professor of Physiology, University of Oklahoma, states: "I have found that the rate of diffusion of the magnesium sulphate with urea

was rather constant; that is, the range was between 30.9 and 32.1 per cent. with the exception of a 6 per cent. solution of the magnesium sulphate and a 1 per cent. solution of the urea which diffused very much faster, it having diffused 48.1 per cent. in the same time. The whole range of percentages were used both with the magnesium sulphate and the urea. Each time the 6 per cent. solution of the magnesium sulphate and the 1 per cent. solution of the urea diffused practically 50 per cent. faster than any other combination or any other substance which I tried."

Hewlatt[7] has given 25 grams of urea every hour until 12 m. (100 grams in all) with no untoward results. Cushney[8] states: "It is rapidly absorbed from the intestine and is practically devoid of action in the tissues even in the larger doses." The amount used, 1 per cent. of a 4 ounce mixture, is therefore negligible as far as danger is concerned. It is used with the idea that it increases the absorbability of the magnesium sulphate. The exact relation between "diffusion" and "absorbability" is not definitely known, nor can we state at this time how much the efficiency of the method is due to the urea.

"Ether[9] is the anæsthetic of choice if the patient is suffering from any form of toxæmia or requires stimulation or is suffering from shock." The amount used in our mixture, two to four drams to a maximum of one and a half ounces, needs no extended comment. (Four to six ounces of ether is the amount used in colonic anæsthesia.)

Ten years after its introduction for general surgery oil-ether was first systematically treated in 100 obstetrical cases by Thaler and Hübel.*

The mixture was 90 grams (3 ounces) of ether and 120 grams (4 ounces) of olive oil. The amount used at one injection was 100 cc. ($3\frac{1}{2}$ ounces) introduced very slowly. In a typical case, a few minutes after injection, the eyelids close and a general relaxation sets in. The condition is suggestive of twilight sleep, but if there is no marked effect after ten minutes a second injection of 50 cc. ($1\frac{3}{4}$ ounces) is given. In only one case was the method entirely impractical. With this

* *Zentralblätt für Gynäkologie*, Leipzic, 47, 337—384 (March 3, 1923).

one exception there was no complaint of pain or irritation of intestine.

In 16	cases	this	injection	(50 cc.)	was repeated once.
„ 25	„	„	„	„	twice.
„ 20	„	„	„	„	three times.
„ 15	„	„	„	„	four times.
„ 12	„	„	„	„	five times.
„ 4	„	„	„	„	six times.
„ 2	„	„	„	„	seven times.
„ 1	„	„	„	„	eight times.

In one case the maximum total amounted to 767 cc., of which 270 cc. were lost. No rectal irritation.

In 88 cases the results were satisfactory.
„ 4 „ there was absolute failure.
„ 80 „ normal or very strong labour contractions.
„ 20 „ labour was reduced or retarded. In these cases quinine or pituitary extract was added.

In some cases the labour seemed to be improved by the oil-ether mixture.

In 73 primiparas average duration of birth 20¾ hours.
„ 27 multiparas „ „ „ 10¼ „

No anomalies of the after-birth period were observed. No change in fœtal heart beat. Usually born pink.

In 84 children condition normal—cried immediately.
„ 14 „ „ apnœic—breathed normally in five mins. without resuscitation.
„ 2 cases typical asphyxia one revived and second—forceps—was not resuscitated.

In the majority of cases during the intervals between labour contractions, the patients lay as if asleep, during labour contractions slightly restless and groaned occasionally.

The time of rectal instillation :—

In 24	cases	the os	was dilated	2—4 fingers.
„ 27	„	„	„	3 fingers.
„ 9	„	„	„	4 fingers.
„ 3	„	„	„	more than 4 fingers.

No morphin or alkaloids were used. In no case was there excitement. Vomiting in five cases. Strong thirst in seven cases. After delivery a deep sleep. Upon awakening do not recall any incidents. Of 99 born alive, one child died on fifth day, after third day intestinal inflammation and subsequently pneumonia. Some children were sleepy during the first one or two days. Ether by inhalation in comparison with this method affects the brain too much.

The disadvantage might be the impossibility of exact dosage on account of loss, but according to the writers the difference of individual reactions makes exact dosage irrelevant. The method is impractical in private homes.

To revert to the synergistic method again the next drug to consider is

Alcohol. The ounce of alcohol was used principally as a vehicle for the ether; it also increases the absorbability of the mixture. Alcohol is below ether in analgesic qualities. *Three-eighths* of a grain of morphin per rectum (in our opinion) is the limit for this drug. The hyoscin is used to accentuate the value or to synergize the morphin.

" The exaggeration of the effects of small doses of morphia which results from its combination with scopolamin is of great practical importance. This synergism may be experimentally demonstrated in various species of animals, especially in those species in which scopolamin alone, even when given in large amounts, produces no narcotic effects. The combined administration of small doses of morphin and small doses of scopolamin, which by themselves produce hardly any effects, results essentially in an exaggeration of the effects of morphin. (Burgi, Madelung.) Morphin and the hypnotics of the alcohol group when administered simultaneously also act synergistically, with a resulting exaggeration of each other's pharmacological actions." (Burgi, Fuhner.)[10]

The Method.

It is the exceptional patient who is so unfortunate as not to have received instructions, among other things, to keep the lower bowel clean, especially in the last stages of labour. The rule at the Lying-in Hospital is to examine and give a cleansing enema when admitted to the hospital. The patient

is then sent to the floor where delivery takes place. The patient is therefore already prepared for the colonic administration of the drugs used, and this is the method adopted. A six ounce mixture seemed preferable, but was too frequently expelled, therefore a four ounce mixture is the final choice.

Time.

In selecting the time for the rectal instillation we seemed to follow naturally the Freiburg method, which is as follows: "After labour is well on its way, when the pains are four or five minutes apart and lasting thirty or more seconds, the first injection (hypodermic) is made." It is at this time that the rectal instillation is given whether in a four ounce mixture or in divided dosage of two ounces. The effect is noticeable about the same time as a hypodermic would be and is not as painful. Analgesia is present in from thirty minutes to one hour after the administration, even in those cases in which a delayed action occurs.

Suitable Cases.

In the development of this method great care is being taken in rejecting cases that would in any way obscure the issue. For instance, if the uterus is dilating evenly and the contractions occur regularly, but with little pain, no medication is given; an even and sometimes painless delivery is then assured; or, when the cervix is fully dilated (four fingers or more) medication is withheld. Again, if the fœtal heart sounds are irregular or bad, or malpositions occur, or if there is any question about the condition of the child, medication is withheld. After starting this method a patient with indistinct fœtal heart sounds was admitted to the hospital. Medication was withheld and the child delivered, but died within forty-eight hours. If the method had been tried in this case it would have properly come under suspicion. The cases selected were those not too far advanced and where there was a possibility of helping them. The selection or rejection of these cases necessarily fell upon the house surgeon of the Lying-in Hospital to whom full credit is herewith given in exercising unusually good judgment.

Results.

The results have varied, but in the majority of cases the patients have been "helped," the "pains were lessened," and in a few a comparatively painless delivery has occurred. Others were not helped in the slightest, while one or two stated that the pains were "intensified." This last statement can only be accounted for by taking into consideration the mentality of the patient who possibly expected very great help and received but little.

Formulæ Used.

In the evolution of this method the various formulæ used and the results, together with Donovan's notes on the cases, are herewith given:—

No. 1. February 10th, 1923.

Morph. Sulph.	gr. $\frac{1}{4}$
Hyoscin Hydrobrom.	gr. 1/200
Sol. Mag. Sulph. 50% C.P.	1 ounce
Aqua Destill.	$\frac{1}{2}$ ounce
Alcohol q.s.	2 ounces

Used on four patients. Dose repeated in one case and no relief. One case with one dose had a practically painless labour. Three cases had no relief.

No. 2. February 10th, 1923.

Glucose	4 drams
Morph. Sulph.	gr. $\frac{1}{4}$
Hyoscin Hydrobrom.	gr. 1/200
Sol. Mag. Sulph. 50% C.P.	4 drams
Egg	1
Alcohol	1 ounce
Pept. Milk q.s.	4 ounces

Used on three patients. One with one dose said pains were worse. Two cases each had two doses with no apparent relief.

Impression: Effect somewhat better than No. 1, but not marked.

No. 2 with ether added (2 drams) used on three patients. All stated that pains were relieved somewhat.

No. 3. February 19th, 1923.

Morph. Sulph.	gr. $\frac{1}{4}$
Hyoscin	gr. 1/200
Sol. Mag. Sulph. 50% C.P.	4 drams
Alcohol	4 drams
Pept. Milk	2 ounces

Given at 110° Fahrenheit

No. 2.

Alcohol	4 drams
Ether	$\frac{1}{2}$ ounce
Yolk of egg	1
Pept. Milk q.s.	4 ounces

Used on eight patients. Four cases the pains were lessened, but all had long second stage. One baby was resuscitated with great difficulty. Condition appeared to be morphin apnœa. Four cases had no evident relief. Two delivered by forceps. *Impression* : Fairly good in four cases, but all had long second stage.

No. 4. February 26th, 1923.

Morph. Sulph.	gr. $\frac{1}{4}$
Hyoscin	gr. 1/200
Mag. Sulph. C.P.	3 drams
Glucose	2 grams
Pept. Milk q.s.ad.	2 ounces

Given at 110° Fahrenheit.

No. 2. Given forty minutes later.

Ether	$1\frac{1}{2}$ ounces
O. Olive	$2\frac{1}{2}$ ounces

Used on five cases. Three had no relief. One expelled part of the second dose. One case was "helped" a little. One case had great relief but a long labour.

No. 5. March 1st, 1923.

Morphin Sulph.	gr. $\frac{1}{4}$
Hyoscin Hydrobrom.	gr. 1/200
Mag. Sulph. C.P.	4 drams
Glucose.	4 drams
Aqua Destill.	4 ounces

Given at 110°. Used on three patients with no relief. To one bottle, paraldehyde 3 drams were added. Patient slept all during labour. Had good progress, but vomited.

No. 6. March 8th, 1923.

Urea	1%
Mag. Sulph. C.P.	6%
Morphin Sulph.	gr. ¼
Hyoscin Hydrobrom.	gr. 1/200
Paraldehyde	2 drams
Ether	2 drams
Pept. Milk	6 ounces

Used on four patients. Two cases helped considerably. Two others noticeably. All vomited and had prolonged second stage. Did not retain six ounces so well.

No. 7. March 13th, 1923.

Urea	1%
Mag. Sulph. C.P.	6%
Morphin Sulph.	gr. ¼
Hyoscin Hydrobrom.	gr. 1/100
Urethane	gr. 5
Ext. Cannabis Indica	gr. ⅛
Water q.s.	4 ounces

Used on six patients. No noticeable effect on three. Pains of one were lessened; two considerably relieved.

No. 8. March 19th, 1923.

Urea	1%
Mag. Sulph. C.P.	6%
Morphin Sulph.	gr. ¼
Hyoscin Hydrobrom.	gr. 1/100
Paraldehyde	2 drams
Ether	2 drams
Urethane	gr. 5
Pept. Milk	4 ounces

Used on two cases. Both were nauseated but rested and pains were lessened.

No. 9. March 20th, 1923.

Urea	1%
Morphin Sulph.	gr. ¼
Hyoscin Hydrobrom.	gr. 1/100
Mag. Sulph. C.P.	6%
Ether	2 drams
Paraldehyde	2 drams
Urethane	gr. 5
Quinine H.C.L.	gr. 10
Alcohol	1 ounce
Water q.s.	4 ounces

Used on four patients. No apparent effect from first two.

Alcohol added to last two; labour was prompt and pains eased a little.

No. 10. Same as above except Morphin gr. $\frac{3}{8}$. No paraldehyde.

Used on four patients. Three of these were helped decidedly. Other case could not be helped with anything.

No. 11. Same as No. 10.

Used additionally upon three surgical cases. All of them had only small amount of inhalation anæsthetic. One case expelled nearly all of the mixture, pains not diminished. One case slept all night after medicine; pains next day were weak and she had a long labour, but the medication gave a much needed rest. Two cases in active labour—one said pains were eased. One case pains were better for about six hours but labour was prolonged, and patient finally was delivered with forceps. Two cases both said pains were eased.

No. 12.

Urea	1%
Mag. Sulph. C.P.	2 to 4 drams
Morph. Sulph.	gr. $\frac{1}{4}$
Hyoscin Hydrobrom.	gr. 1/100
Glucose	4 drams
Aq. Dest. q.s. ad.	2 ounces

Heat to 110° F. Give as retention enema.

No. 2. Twenty minutes later give:

Ether	$1\frac{1}{2}$ ounces
Oil	6 drams

The amount of magnesium sulphate in the above formula varied from two to three drams for obstetrical cases, and to four drams for surgical cases.

One case, 3 drams, was "helped considerably."

One case, 3 drams, pains stopped, patient slept for nearly 20 hours then delivered promptly.

One case, 2 drams (2 omitted), no effect.

Two cases, 2 drams, both helped.

One case, 2 drams, "helped slightly" (slept about three hours), labour good.

Two cases (as written), both "helped."

One case (as written), could not be helped with anything. Rested for seven hours, but it apparently did not ease the pains.

Remarks.

It is stated authoritatively "that no drug which can so far abolish sensation as to make labour painless can be given to this degree without affecting considerably the normal process of labour." We cannot entirely concur in this statement, although it seems to be the consensus of opinion of all obstetricians and of all authorities. (As yet magnesium sulphate alone has not been tested for confinement cases.) By using the minimum dose of a number of drugs synergistically it is believed that the above objection has been overcome. It must be remembered that when the four ounce mixture is placed into the rectum it is still practically outside of the body.[8] When absorbed into the blood it is only then a part of the circulatory system.

"In twilight sleep fœtal asphyxia occurs in 9.6 per cent. of cases, but fœtal mortality is not above the average."[9] In our series the percentage is less than 1 per cent. and this case was not fatal. The usual objections against twilight sleep: (*a*) prolonged labour for hours and days, use of forceps more often necessary, the percentage of ruptured perineums higher, failure of occipito-posterior positions to rotate normally, (*b*) restless delirium and violence, disturbance of heart and lungs, post-partum hæmorrhage and uncertain results, do not seem to obtain with the present method.

In our series only in one case in 64 did asphyxia occur which gives a percentage of .64. As a general proposition "synergistic analgesia" is a safer condition than either oil-ether analgesia or "twilight sleep." In twilight sleep too much dependence is placed upon morphin and its action is too greatly stressed—hence the high percentage of asphyxia. With the synergistic method we attempt to secure relaxation with the magnesium sulphate as well as using it for its power of prolonging the effect of the morphin. Ether is a powerful stimulant and analgesic as well as an anæsthetic. The attempt is made here to use it only for its stimulating and analgesic properties, and we believe we obtain this by using it in the minimum dosage as given.

Incidentally, in the last formula 12, a very safe preliminary for surgical cases where full relaxation is required has been evolved. It is given one hour before the operation as a retention enema, and is put up as a four ounce mixture and supplemented by nitrous oxide oxygen-ether open method. It has been used in several hundred cases with satisfaction.

Conclusions.

We feel that in this small series of cases we have established the fundamental principles upon which painless labour may be safely worked out, *i.e.*, by using the minimum dose of a number of drugs, compatible and synergizing, using each drug for a definite and specific purpose.

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The term *synergistic anæsthesia* means the reciprocal augmentation of the action of one or more drugs upon one another with unconsciousness. *Synergistic analgesia* is the term employed when consciousness is present. When the agents are properly selected and used the resulted effect is much greater than the simple summation of their pharmacologic action. J. T. Gwathmey.

SACRAL OR EPIDURAL ANALGESIA.

By J. Blomfield, O.B.E., M.D.

SACRAL analgesia has not yet been used to so large an extent in Great Britain as to render useless any further account of personal experiences, even if these do not involve a huge number of cases. Accordingly I have been through the notes made at the time whenever I have employed the method, and venture to put before the readers of this journal a brief account of the exact technique adopted and of the conclusions arrived at.

History.

The short history of this form of analgesia may be recalled in a few words. In 1903 Cathelin showed by experiments on animals in which cocaine was employed, that injections of a 1 per cent. solution of the drug into the sacral canal caused anæsthesia of the whole body. No real use of this fact could be made in human practice until less toxic drugs than cocaine were available. In 1909 epidural injections of novocaine were employed to reduce the pains of labour. Stoeckel injected 30 cc. of a $\frac{1}{2}$ per cent. solution. In the following year, by using larger amounts and a stronger solution, Loewen produced an analgesia which sufficed for operations on the perineum and genitals.

A paper by Captain S. R. Meaker, in the *British Medical Journal* of May 10, 1909, gave a good account of technique and results. Since then numerous cases have been recorded, and the method has been widely employed for operations on or investigations of the anus and rectum, the urethra and bladder. By using small amounts of injection minor procedures in these regions have been safely conducted in out-patient practice. Of this I have had no experience, nor do I think it is a proceeding to be recommended.

Albert Scholl, in the *California State Journal* for December 1922, giving experiences in urology with sacral analgesia, recommends novocain with bicarbonate of sodium. His formula is :—

Sod. bicarb.	0.15 grm.
Sod. chlor.	0.1 grm.
Novocain	0.6 grm.

According to Scholl, adding sodium bicarbonate causes the solution to diffuse more readily through the nerve sheaths, the result being a more intense analgesia with less chance of failure.

Preliminary narcotics. When no hypodermic injection is used beforehand injection into the sacral canal may cause considerable pain as well as a good deal of uneasiness and restlessness. It has always appeared to me paradoxical that there should be any pain associated with a process intended mainly for its prevention. To hurt a man while providing him with anæsthesia is ridiculous. Consequently I have always employed preliminary narcotics freely before sacral analgesia. As a general rule omnopon gr. $\frac{1}{3}$, scopolamine gr. $^1/_{100}$, atropine gr. $^1/_{120}$, have been given in one injection an hour and a half before the time of operation, and omnopon gr. $\frac{1}{6}$ half an hour before. These injections have rendered some patients drowsy and quite indifferent to the sacral injection. Others have been much more slightly influenced, but although not at all drowsy have endured the sacral injection with an indifference that is wanting in those who have had no preliminary narcotic at all. The only occasions when a preliminary narcotic may be omitted are when a minor proceeding is to be carried out on a man who is not of a nervous disposition.

Preparation.

The patients have always been prepared as regards food in the same way as though a general anæsthetic were to be administered. This appears wise in employing a method that still provides, even in most skilled hands, as large a percentage of failures as 15 per cent. Moreover, the preliminary narcotics prevent any noticeable desire for food by the time of operation.

Position. The patient lies comfortably on one side. If the operation is a lateral one, *eg.*, for an inguinal hernia, it is best for him to lie on the side to be operated on. For piles, bladder operations and the like, he may lie on which side he prefers. The thighs should be a little flexed and the back a little rounded, but there is no need, of course, to aim at the extreme arching which is desirable for spinal injection. Some authorities prefer the patient to lie prone, with the lumbar and dorsal spine raised above the level of the sacrum. This position is not nearly so easy for the patient, and as making the injection occupies a considerable time in some cases it is essential that the position should be one that

is easily and comfortably maintained. I have found no reason to give up the side for the prone position, and when there has been difficulty in finding or entering the sacral hiatus this has not been removed by putting the patient on his face.

Accessory details.

It is important that every disturbing element should be absent from the patient. The more completely his special senses are left entirely unstimulated the easier is it to bring about a satisfactory analgesia. Thus his ears may with advantage be lightly packed with cotton wool, and a towel folded across his eyes. He should lie on the table on which the operation will be performed so that there is a minimum of movement of his body after the injection has been made. Several observers have met with violent convulsive attacks after sacral injections, and Rood informed me that in his opinion attacks of this kind had been brought on by moving the patient. At any rate, none of my subjects have been affected in this particular way, and we have always laid stress on the importance of moving the patient after injection as little and as gently as possible. These epileptiform seizures are attributed by some to too large an amount of solution being used, but I have injected 200 cc. without any disturbance of the kind. The convulsions are accompanied by some cyanosis, and should be treated by administration of oxygen.

To make the injection. The skin is cleaned with iodine over the sacral spines down to the anal cleft. Sterilized towels surround the buttocks, perineal and sacral areas, and the anæsthetist's hands are carefully cleansed. With his left forefinger he defines the sacral hiatus by feeling the depression between the cornua of the sacrum. This pit he will generally find about an inch above the tip of the sacrum felt at the upper end of the anal cleft. Keeping his finger over the hiatus he takes the hypodermic syringe in his right hand and injects a few drops into the skin, guided by the pulp of his left forefinger. The needle used for this purpose is the ordinary slight one of a hypodermic syringe. Now he takes the needle of a Record syringe, at least a couple of inches in length, and pushes it through the skin at the spot where he has already made his injection. At the depth of about half an inch or less he will pierce the membrane guarding the sacral hiatus. He then lowers the shaft of the needle till it lies in the axis of the sacral canal and pushes it upwards for about an inch and a half. If he is properly in

the sacral canal he can move the needle easily from side to side, but scarcely at all from before backward. This being so, he attaches the Record syringe and slowly injects the solution. The ease with which this runs in affords a further proof that the needle is properly entered into the canal. Also no visible swelling is produced even when large quantities of solution are run in. On the other hand, if the needle is not in the canal it is either very difficult to force in the solution or else a superficial swelling rapidly appears and increases with the increased injection. It is quite easy to break the needle in the firm fibrous tissue bordering the sacral hiatus, and for this reason no force must be used in trying to make the needle travel onward. If it does not go easily, or if blood flows at once showing that a vein is entered the needle should be withdrawn and a fresh entrance made.

The implements necessary are :—

(1) Sterilized basin holding 100 cc. of 2 per cent. freshly made stovaine solution, to which have been added 20 drops of 1 in 1000 adrenalin.
(2) Record syringe to hold 20 cc., fitted with needle two inches long.
(3) Small hypodermic syringe and needle holding 5 cc. of the solution.

The amount of solution to be injected should vary in accordance with the site of the operation to be performed. The higher the level of the body at which this is situated the greater must be the amount used. At the same time it must be remembered that even when analgesia is required only for the anal area, or the urethra, failure is more likely if only small amounts of solution are injected. In my own experience 30 cc. of a 2 per cent. solution has been the minimum with which satisfactory analgesia has been obtained. When a weaker solution is used analgesia takes longer to appear, and of course larger amounts are needed. There should never be haste in the course of a sacral administration. Twenty minutes at least are required for the full development of the analgesia, and the actual injection of the solution must be firmly but quite delibrately carried out. Unpleasant symptoms have arisen only when large amounts have been used. These phenomena may be merely rapid pulse with slight nausea and dizziness, or they may be breathlessness with failing pulse or actual collapse. The administration of

oxygen and injection of caffeine appear to be the most effective remedies, but I have had no experience of treating serious symptoms caused by sacral injection. It appears to me highly probable that the adrenalin in the solution is the cause when these undesirable effects are produced, and if large amounts of solution are necessary I prefer to omit that ingredient.

Features of the analgesia. The height to which analgesia extends is uncertain, but depends largely, as has been said, on the amount of solution injected. The skin of the face may be quite insensitive after an injection of 100 cc. Sense of touch and of pressure is often not abolished although analgesia is at the same time quite satisfactory. The pressure of the knife's edge is realised but without any sensation of pain. Motor paralysis of the lower limbs is rarely complete. Ability to move the feet or toes has been present in most of my patients.

Safety. Experience up to the present shows that if sacral injection is confined to cases in which analgesia is required for the rectum, bladder, perineum or genitalia, if, that is to say, large amounts of solution are not injected, then the procedure is almost free from risk. When it is a question of higher levels of analgesia the chance of danger is greatly increased and it may well be doubted whether there is any advantage in sacral over intra-thecal spinal injection.

NEW ANÆSTHETICS.

By C. Langton Hewer, M.B., B.S.

THE four anæsthetics in common use, *i.e.*, chloroform, ether, nitrous oxide and ethyl chloride, are now so well known that we are apt to overlook the possibility of other agents being of practical use. In late years, however, a good deal of research work has been done on anæsthetic gases, and the two which hold out most promise at present seem to be ethylene and acetylene.

Ethylene.

The anæsthetic properties of ethylene have been recognized for many years. In 1864, Hermann[1] anæsthetized himself with ethylene and described the experience as being similar to that produced by nitrous oxide. Johannes Müller, Davy, Simpson, and Nunnelly all made similar demonstrations upon themselves. In 1876, Eulenberg,[2] and in 1885, Lüssem[3] published detailed observations upon animals. The latter produced satisfactory anæsthesia, using a mixture of 80 per cent. ethylene, and 20 per cent. oxygen. Since that date interest in ethylene appears to have lapsed until 1917, when Cotton,[4] having demonstrated that chemically pure diethyl ether had little if any anæsthetic action, showed also that ethylene dissolved in the ether produced an efficient anæsthetic. In 1920, Wallis[5] confirmed these observations, but carried the investigations a stage further by showing that ethylene prepared from different sources, *e.g.*, from sulphuric and phosphoric acids, behaved differently. He believed that most of the anæsthetic action of the ethylene was due to traces of Ketones, and demonstrated that a large number of these compounds were themselves anæsthetics. These researches have stimulated considerable interest in ethylene, and the recent experiments by Luckhardt and Carter[6] at Chicago, and by Brown[7] at Toronto have fully confirmed the results obtained by previous workers. There appears to be no doubt that ethylene has considerable advantages over nitrous oxide, and arrangements are now being made for an extensive trial

of the gas in this country, and it is hoped that the results will be fully published in a short time.

Acetylene.

The first mention of acetylene as an anæsthetic was possibly made by Lewin[8] in 1885. Ten years later, Rosemann[9] published detailed results in cats using from 15 to 20 per cent. by volume of acetylene. Since that date the objectionable odour has discouraged further investigations until recently when Gauss[10] has shown that chemically pure acetylene has little odour and even this trace can be disguised by oil of pine. Horwitz,[11] speaking of a personal visit to Gauss' clinic at Freiburg, states that over 500 cases have been successfully operated upon under a mixture of acetylene 40 per cent. and oxygen 60 per cent. The apparatus used by Gauss is extremely complicated, but in its essentials differs in no particular from a gas and oxygen machine. The advantages claimed from acetylene are good relaxation, rapid recovery and freedom from after effects. Wallis has found that pure acetylene (prepared from cuprous acetylide) dissolves in pure ether to a considerable extent and increases its anæsthetic power. On keeping, however, some chemical change apparently occurs, and the characteristic odour of acetylene becomes obvious.

These observations appear to be of great importance, and there seems no reason why a gas superior to nitrous oxide should not be found. At the same time, however, researches with ethylene and acetylene are by no means devoid of danger both to the experimenter and experimentee, and the wise Anæsthetist will do well to leave them severely alone until such time as their mode of action has been completely worked out.

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BOOK REVIEWS.

"Practical Local Anæsthesia and Its Surgical Technique." By Robert Emmett Farr, M.D., F.A.C.S., Minneapolis, Minn. London: Henry Kimpton.

For those who have the inclination and the opportunity the field of research in Anæsthesia is a broad one. Investigation may be conducted from such various standpoints as the physiological, psychological, chemical, pharmacological, mechanical and surgical. One has but to glance over the current bibliography or the programme of societies to realize how far the subject has been advanced since the days of Morton and Simpson. Aside from the more familiar general anæsthetics there is practically an unlimited field in local or regional anæsthesia, the extent of which is well illustrated by Farr's "Practical Local Anæsthesia," just to hand.

This work may be said to comprehend the entire field of local anæsthesia, and will be found useful for the surgeon as well as the anæsthetist. The chapters on Equipment and Technique are replete with information for those desiring to go into this branch understandingly, the author having reviewed such subjects as infiltration and conduction anæsthesia and their allies very learnedly. The portion of the book devoted to the practical application of local anæsthesia impresses one with the breadth of its possibilities, and evokes admiration for its commendable explicitness as well as the wide range of cases worked out.

A phase of the subject stressed by the author is what might be termed "extraneous" anæsthesia. He repeatedly refers to the value of the psychic element in anæsthesia, and goes so far as to employ a "psycho-anæsthetist" in many of his cases. This, undoubtedly, is a field to be investigated further.

A word must be said in praise of the large number of illustrations and their lucidity. Mr. Ralph L. Witherow, who is responsible for most of the drawings in the work, has again demonstrated the high degree of perfection the art of medical illustration has attained.

REMARKS ON BRONCHO-PULMONARY COMPLICATIONS FOLLOWING OPERATIONS UNDER ANÆSTHESIA.

By W. J. McCardie, M.B., B.C. (Cantab.),
Hon. Anæsthetist to the General Hospital, Birmingham, etc.

IN my opinion the most important question in anæsthesia to-day is that which appears in the title of this, I fear, somewhat discursive paper. At the Annual Meeting of the British Medical Association in Glasgow last year, Dr. Lamb gave to the Anæsthetic Section an admirable and judicious opening presentation of this subject. His early statement that "graduates going out into the world from this School know little of the peace of mind of the anæsthetist engendered by the use of ether," and "the number of fatalities occurring annually in this city from chloroform in the hands of comparatively inexperienced anæsthetists, would probably surprise, if not startle, the adherents of this old doctrine," and that many graduates from the Glasgow School are still under the impression "that the administration of ether is frequently, if not usually, followed by bronchitis and pneumonia or cardiac failure, and that whilst occasionally patients die on the table under chloroform, far more die after the operation from the above complications when ether is used," are remarkable in these days. I would suggest that the two latter statements be supported or contradicted by statistical evidence drawn from hospital and private practice in Glasgow and presented before a joint meeting of surgeons and anæsthetists.

In my own experience broncho-pulmonary complications are much more frequent in hospital than in private practice. I am unable to get correct figures of the former, but those I have recorded in about 14,000 hospital administrations are certainly far more proportionately. If we can find the causes of this difference we shall be helped in our enquiry, because, I take it, the anæsthetics used are the same in hospital as in private work.

I have kept a record of cases which occurred in private work from November 1898 to July 1922, and in 10,069 administrations of various anæsthetics by various methods for all sorts of operations, have noted 28 severe broncho-pulmonary affections, which occurred within three or four days after operation. Roughly these can be

classified as follows :—Bronchitis (severe), 10; pneumonia, including one septic, 16—five deaths; pleurisy, 2—one death; total, 28—six deaths; that is one case in 359, or about .3 per cent.

Deaths.

In five out of six ether was wholly or chiefly administered. Three of the fatalities were after high abdominal operations. One took place after an operation under chloroform for amputation of the breast.

In all fatal cases the patient was of middle age; that is, from 37 to 56 years.

Several other patients have died from pulmonary embolism, a condition which I consider is mainly due to the surgical intervention.

No post-mortem examinations were held.

In addition there happened recently what may be called a "pre-pneumonic" death; that of a man 56 years of age, a chesty person, of full habit, who died within 24 hours after high abdominal exploration, with every sign of respiratory exhaustion and embarrassment and secondary heart failure. He was found to be suffering from pancreatitis. E_2C_1 + ether freely and openly was the anæsthetic.

I have known of several other like cases.

Respiratory complications have occurred more frequently in recent than in former years (and more often in males than in females), largely owing to the more severe type of operations nowadays and to the fact that these occur in greater proportion in middle age.

The position in its most acute form is presented to us in some such case as this. A middle-aged patient who has rigid chest, cough, some emphysema, some degree of myocardial and arterial degeneration, undergoes a severe and prolonged high abdominal operation. Because of his poor condition and the severity of the operation the anæsthetic is ether. In such a case the site of operation, the exposure and chilling near the diaphragm and lungs, the strain of forced diaphragmatic breathing and surgical interference with it, perhaps a pillow under his ribs, the very deep anæsthesia, which so often can only be safely gained by etherization, the limitation of breathing by pain and bandages after operation, not to speak of exposure and chilling of the body in various ways, will not infrequently bring about pulmonary complications. Thus

many factions may come into action, responsibility for which both surgeon and anæsthetist must share. It is for us to discuss the factors, including the anæsthesia, which may influence the development of pulmonary complications.

Frequency.

In the early days of anæsthesia, chloroform was accused of causing bronchitis, and an irritative "chloroform bronchitis" was described. Recently ether is the only anæsthetic which has been severely and more or less unjustly incriminated. Many records, giving varying results have been published, and much literature has appeared, particularly in American journals.

Years ago McNaughton-Jones stated that in the course of about 30 years' practice he had never seen a case of severe pulmonary affection after ether narcosis.

Pridgin Teale, during more than 20 years of almost exclusive use of ether in private surgical work could only recall one fatal case of broncho-pneumonia.

Recently Kaathoven has recorded 2,500 anæsthesias under ether without serious complication and without pneumonia or bronchitis. He gives a little chloroform if relaxation be not obtained and uses light anæsthesia.

Bloodgood says that pneumonia has practically disappeared from his clinic since the routine use of local anæsthesia with gas and oxygen, with more careful pre-operative treatment and prevention and treatment of shock. Lately he has used open ether instead of gas and oxygen, with the same result. He says that the reduction of the amount of general anæsthetic by local anæsthesia is the essential factor.

On the extreme contrary, Sonntag is quoted years ago as having, in 38 ether narcoses, observed six pneumonias, four of which were fatal—a terrible state of things—and Kaathoven gives figures from an American hospital in which 18 pneumonias occurred in 1,800 cases, of which 13 were fatal; that is, 1 per cent. pneumonia, and .7 per cent. mortality. Between these extremes statistics vary very widely. Perhaps figures given by McKesson may be taken as an average. (In the majority of cases, I presume, the anæsthetic was ether.) He says that "in a compiled series of 39,438 operations under all forms of anæsthesia lung complications followed in 3 per cent. of the cases in which figures are available. There was a total

mortality of 1 per cent. Of these lung complications 48 per cent. were pneumonias; of the pneumonia cases 48 per cent. were fatal. I could quote further statistics.

There is generally a difference, no doubt, between incidence in hospital and private work, because hospital cases are often in a poorer condition orally and constitutionally, do not have so much individual attention, and are often anæsthetised by inexperienced anæsthetists. The hospital patient is usually returned to a general ward at about living-room temperature, while a private patient is sent back to what is practically a small recovery ward specially warmed, and is specially nursed.

The figures given by Drs. Lamb (70 per cent.) and Featherstone at the Glasgow Meeting last year, as to the number of patients from surgical wards who showed post-mortem evidence of chronic respiratory trouble are impressive. Their results show how careful we should be in our preliminary treatment and choice of anæsthesia. One cannot, unfortunately, as a rule get post-mortem records after deaths in private practice.

It has been said, "that for every death on the operating-table there are 50 deaths from the later pulmonary complications. It seems, therefore, a huge mockery that the safest anæsthetic is proven now to bring in its wake the largest post-operative fatality." This startling pronouncement appeared in an editorial article in the *Journal of the American Medical Association* about three years ago.

So many factors enter into the causation that probably no single cause can be incriminated. Anæsthesia cannot, however, be disregarded, otherwise there would be no object in choosing a particular drug or method for anæsthesia in "chesty" patients. Of these factors the more important appear to me to be—

1. Pre-existing respiratory affections.
2. Exposure before, during and after operation.
3. High abdominal operations.
4. Saturation, over-stimulation and consequent exhaustion by inhalation of stimulating anæsthetic vapour.
5. Middle and old age.

Surgical manipulation, especially in abdominal work, in which abdominal viscera or ducts are opened, may be followed by infection of the lungs. Sepsis, of course, may spread.

Depth of Anæsthesia.

Saturation by stimulating drugs may cause over-action of the lungs (forced breathing) and heart, and consequent exhaustion of these organs. I have often noticed that patients suffer less after what is sometimes called a "badly given" anæsthetic, that is, light and often intermittent anæsthesia, than after a so-called perfect one, and that there is then less tendency to respiratory complications.

We know that "after anæsthesia the power of the blood to destroy pathogenic bacteria is markedly reduced, so that the state of a man after a long anæsthesia is comparable to that of an alcoholic with bronchitis who has been sleeping off an overdose of alcohol in a doorway."

Exposure and Chilling.

According to a recent questionaire by Lumbard, in America, as to the most potent cause of pneumonia, 63 out of 130 anæsthetists replied, "exposure in some form or other." Warming ether vapour is said by Corlette to save less than one calorie per hour. He emphasizes the danger of cold, dry and draughty air. It has been found that Jewish patients in a poor quarter of New York used to suffer from post-operative lung troubles in hospital because they were insufficiently clad. When supplied with the warm clothing they were accustomed to things improved. "As to the close association of pneumonia with exposure there can be no question" (Osler).

Paralysis of the thermic centres is caused by deep anæsthesia, and the patient is for some time in the position of a de-cerebrate animal. Heat loss from over-work and sweating by a stimulant anæsthetic may be great. The air of the operating theatre should be warm, still and moist. Heat loss is more important in old than in young people. It is proportional to the superficial area of the patient, that is, depends upon the amount of heat loss from the surface. This surface may be largely increased during an abdominal section; as a matter of fact the fall in the patient's temperature is greater in abdominal section than during extra-abdominal operation. About 87.5 per cent. of heat is said to be lost through the skin, and about 10.7 per cent. through the lungs. Children and small people have a much larger skin surface in proportion to their weight than adults or larger people. These facts are significant in relation to prophylaxis.

Preparation.

Every effort should be made to minimize previous lung troubles by prolonged preparation, preferably rest in bed for some days and careful treatment of any lung lesions. Oral sepsis must be rigidly eliminated.

Ventilation.

One wonders what is the influence of the plenum system. There is certainly more constant draught with the latter. Would a draught tend to spread infection in the wards? Silk asserts that in open-air hospitals bronchitis is unknown after operation.

Site of Operation and depth of Wound.

Broncho-pulmonary complications are more frequent after abdominal operations, especially after high abdominal operations. William Mayo writes: "The pelvic peritoneum, through long experience, has acquired a remarkable resistance to infection, which is not shared by the peritoneum of the upper part of the abdominal cavity. To reach the general circulation from the lower part of the abdomen infective material must pass through the portal circulation of the liver, the great organ of protection. From the upper half of the abdomen infective material passes into the mediastinal spaces and reaches the general circulation direct, resulting in the complicating broncho-pneumonia, which is so often the cause of death in cases of septic peritonitis. This is particularly true of the central tendon of the diaphragm through which solid particles may pass." The nearer the site of operation is to the diaphragm, generally speaking, the greater the risk of lung infection.

Type of Patient.

The tendency to lung complications is greater in the older than the younger, in the stout than the thin and less in children. The work of the respiratory machine under a stimulant anæsthetic is comparatively more severe in middle aged and chesty persons than in younger patients, in whom complications are usually of the broncho-pneumonic type.

There is a "peritoneal" type of patient whose breathing is catchy and spasmodic when his peritoneum is interfered with. Such an one needs a very deep anæsthesia to ensure relaxation, so much so that a little chloroform is often necessary. His breathing

after operation is often unusually restricted by pain and spasm, and he is more likely to develop some chest complication.

Season.

Season influences incidence, respiratory affections being, in winter, more frequent and exposure to cold is more likely to occur.

Nature of Anæsthetic Administered.

With regard to the particular anæsthetic and method of anæsthesia, we badly need more recent comparative figures. It is so easy nowadays to give ether by the open method and to safely saturate the patient that we are apt to forget that there are other anæsthetics, and that often a very light anæsthesia will wholly or temporarily suffice for the surgeon's need. The very fact that we avoid the use of much ether and resort to other anæsthetics in patients suffering from broncho-pulmonary diseases whenever we can shows that we admit it has some definite, though probably small, influence in increasing or producing pulmonary lesions. There is no doubt that among general anæsthetics gas and oxygen is less frequently followed by respiratory complications than any other. This is probably due to the lightness of the anæsthesia maintained and not to any inherent virtue in the mixture. One is apt to forget that a gas and oxygen effect can also be produced by ether and chloroform, if only one will try for it.

Aspiration from the mouth is not, even in these days, to be neglected as a cause, in spite of the administration of atropine. The Trendelenberg posture effectively prevents the development of aspiration pneumonia; in fact lung complications seem to be comparatively infrequent in patients who have been operated on in this posture.

Warm Vapour.

I cannot think that warming the anæsthetic vapours has much influence in lessening lung complications. I have frequently and for long periods administered cold ether or chloroform vapour through a mouth-tube directly to the epiglottis, and have never seen any after-effect, and have not known of any happenings when ether vapour has been administered intra-tracheally.

Epidemic.

Lung complications may be epidemic in a ward or affect patients in particular beds in a ward. I have known of a series in the same

ward more than once, and also of a sequence of two and three cases of pulmonary complications in the same private room. Hence it is not wise to put a patient to bed next to another suffering from pulmonary disease or in a room previously infected.

Exhaustion.

Exhaustion due to operation or the over-stimulus of anæsthesia may end in respiratory and cardiac weakness with consequent hypostatic "pneumonia."

Prevention.

Prevention should include :—

Prolonged preparation, say a week in big abdominal cases, especially where there is any affection of the upper air passages.

Cleansing of mouth, nose and tonsils.

Preliminary polyvalent vaccines, where indicated, and possibly the administration of digitalis to keep up blood-pressure and prevent circulatory stasis.

Proper choice of anæsthetic.

More local and regional anæsthesia, alone or combined with general anæsthesia.

No preliminary morphine in chesty or high abdominal cases and none after operation till pain occurs, because the return of respiratory control and activity is delayed. Morphine should then be given in such full doses as to prevent pain on deep breathing or coughing.

Light anæsthesia. It is concentrated vapour that kills and weakens vital function. As far as anæsthesia counts in the production of respiratory affections it is all important that it should be light. In the Mayo's Clinic the very lightest anæsthesia is used in the middle part of an abdominal operation.

Light bandaging.

Warmth during operation and recovery. The theatre temperature should be about 80°F. The patients should be returned to a warm recovery room, especially if abdominal cases, as warm as the theatre till shock is over. The patient's bed should be placed close to the fire or source of heat, while he is away in the operating room and afterwards.

Kellog recommends during operation frequent cold compresses applied every five minutes to the patient's chest, which is rubbed

vigorously with a dry cloth each time the compress is changed. These applications prevent, he believes, pulmonary stasis during anæsthesia and promote deep breathing. After operation he places the patient at once in a warm pack and then has him rubbed down.

Atropine. It must be remembered that the effect of atropine in stopping secretion disappears a long time before chloroform or ether are eliminated from the lungs, and that, therefore, there may be continued irritation and possibly inhalation of mouth secretion during a prolonged recovery. I believe that it would be wise at times to give a second dose of atropine when the patient is returned to bed. Rapid recovery of consciousness should be promoted in every way, even by administration of oxygen, and possibly intra-tracheal insufflation of air or oxygen if the patient has been subjected to prolonged and deep anæsthesia.

Administration.

With regard to respiration through the nose or mouth, I am inclined to think that oral respiration is not always the better. Too free oral respiration, especially when an air-way is used, makes for very large and sometimes too forced (reflexly) intake of irritating vapour direct to the lungs; then saturation occurs with chilling, and, especially in certain types of open air-way, direct carriage of infection to the lungs from the mouth. The retention of an air-way indicates deep anæsthesia. The contact of the air-way with the deep and sensitive parts of the throat seems to stimulate respiration. Very free mouth breathing takes the vapour to every part of the lungs without filtration and warming by the nose. Because of its congesting and irritating properties ether cannot usually be freely breathed through the nose, hence is needed an open mouth or oral air-way. With chloroform there is no need for a mouth tube because respiration, being shallow, the less irritating vapour can be usually respired through the nose and is not carried to the very bases and apices of the lungs. Thus the condition is like that of ordinary sleep and the vapour is warmed and filtered.

Forcible breathing may convey toxic mouth material to the hitherto sterile trachea and bronchi, and is therefore often better damped down by the administration of morphine.

I am not satisfied that the open method of administering ether is the better from the point of view of lung complications. I fancy, and I know of surgeons who agree, that these are less likely to

occur after a closed than after an open administration. There used to be an old, and I believe true, idea that half an hour's etherization was enough for any patient, and that thereafter change should be made to chloroform.

When safety is well established there is no need for over-stimulation. After all, what is stimulation but irritation?

The ideal anæsthesia is that in which respiration, circulation and blood-pressure are kept throughout about normal, but nowadays, owing to the severity of operation we have to allow a fairly large margin of immediate safety during it.

It would be interesting to have figures showing any lung complications after the newer drugs, *e.g.*, Cotton process ether and ethanesal.

With regard to special methods of anæsthesia, such as intra-tracheal, rectal oil-ether, gas-oxygen, local anæsthesia, we, at any rate, in this country, rarely hear of any after-complications, but Mikulicz, Griffin and some other writers state that chest complications are almost as numerous after local as after general anæsthesia.

Types of Lesion.

Very definite types are described, and in series so defined that one wonders that the particular type so overwhelmingly predominates in the particular hospital.

Pulmonary embolism is generally sudden and fatal, most common after pelvic operations, next after gall-stone operations. It is generally due to mechanical action causing local injury, and therefore need not concern us much.

Pulmonary infarction is characterized by sudden onset and subsidence. It occurs a few days after operation, is not very fatal, is due to trauma, mobility of the part or sepsis. It is said that there is no proof that chilling is the cause.

Inhalational complications follow previous infection of the respiratory passages, or pulmonary disease, *e.g.*, bronchitis, especially in the middle-aged after high abdominal operation. They occur immediately and early, and disappear gradually. The mortality is high.

Massive collapse of the lungs may result from paralysis of, or acute inflammation in the neighbourhood of, the diaphragm, the diaphragm being the direct expander of the lower ribs. It may closely simulate pneumonia, and sometimes subsides in 24 hours.

It may become inflamed. There are signs of consolidation and the heart is displaced to the affected side.

There may occur septic pneumonia, bronchitis, pleurisy, hypostatic pneumonia, pulmonary œdema or mucus inundation.

At the meeting of the section of Anæsthetists in Glasgow last year Dr. Lamb suggested that a questionaire to anæsthetists and hospitals be sent out. This I think should be undertaken by the Societies of Anæsthetists. We want to know what proportionate influence anæsthesia *per se* has in the causation. We wish to know what is the difference between hospital and private records and why this difference exists. We want also to know the influence of the particular anæsthetics and methods of administration and to appraise the various other important factors.

Conclusion.

There are very many factors which have varying importance in the causation of broncho-pulmonary complications. I am forced to the conclusion that general anæsthesia in some degree influences the incidence of broncho-pulmonary complications, and that the proper choice of the anæsthetic, degree of anæsthesia, and method of administration, are important factors in prevention. Etherization, especially if deep and prolonged in certain types of, and especially the chesty type of, patient and particularly in high abdominal operations, may be influential, especially if accompanied by exposure. The combination of local or regional with general anæsthesia should be employed if possible in all cases where there are pre-existing respiratory lesions and oxygen freely added to conserve respiration. Prolonged preliminary preparation and careful after treatment of patients subject to any form of nasal or respiratory catarrh or chronic respiratory lesions is essential.

It is for us, as anæsthetists, to elucidate and apportion the value of these factors, and by observing, freely and frankly recording, discussing and publishing our results to help in eliminiting them. To this end the anæsthetist needs the collaboration of surgeon, physician, radiologist, pathologist and nurse, and especially that of the surgeon before and during operation.

ABSTRACTS OF CURRENT ANÆSTHETIC LITERATURE.

La Presse Médicale, 3rd Jan., 1923.

J. Dumont describes *a simple form of gas and oxygen apparatus* invented by Desmarest and Amiot, and declares that the object of the communication is to convince French surgeons that their prejudices against this method of anæsthetizing are mostly unjustified. He says that he was not altogether impressed by what he saw of the method in war hospitals, and that he drew the conclusion that the quality of the anæsthesia produced often bore an inverse ratio to the complication of the apparatus employed; and that good anæsthesia depended more upon the clinical judgment of the administrator than upon mechanical regulation of the dose. The apparatus described is simple and portable, and, during administration, can be placed on the table beside the patient's head; it will deliver any mixture of gas with oxygen or ether or air, but the author does not consider it necessary to give oxygen when ether is being employed. Dr. Dumont adds a word of warning with reference to the use of morphia in children, or in anæmic, shocked or cachectic subjects, as he considers it may increase the tendency to nausea and vomiting.

Marc Roussiel, in an article entitled *Anæsthesia of the Splanchnic nerves and of the superior and inferior mesenteric plexuses,* describes a simplified form of paravertebral anæsthesia produced by a single puncture on each side of the twelfth D.V. which renders insensitive the stomach and portion of large and small intestine, and to which is added local or regional anæsthesia of the abdominal wall. In operations involving the descending colon, the spleen, or the kidney, a modification of the technique is necessary, by means of which, without a fresh puncture, the anæsthetic fluid is injected into the cellular tissue on either side of the first L.V. It is found that by means of this slight modification a more complete anæsthesia is obtained both of the viscera and of the posterior parietal peritoneum.

La Presse Médicale, 13th Jan., 1923

Prof. G. Cotte of Lyon advocates *regional anæsthesia in operations on the uterus.* His cases have included dilatations and curettages, also cervical myomectomies. The technique consists in pulling down and fixing the cervix, and injecting a 1 per cent. solution of novocain into the base of the broad ligaments, and, if possible to locate them, into the utero-sacral ligaments, as well as infiltration around the neck of the uterus. The author claims that by this means dilatation is rendered rapid and easy.

La Presse Médicale, 17th Jan., 1923.

Louis Jube describes a very *ingenious form of syringe* (capacity 15 ccm.) for use in blood transfusion. The apparatus is placed between the arm of the donor and that of the recipient, and is connected with the respective veins by short rubber tubes. There are no valves, but a " valve " action is obtained by means of a groove cut in one side of the plunger of the piston and extending from one end of it to within half an inch of the other end; the plunger is a little more than half the length of the barrel, and thus always overlaps the afferent and efferent parts which are situate opposite one another at a point midway between the two ends of the syringe. The " valve " action is obtained by rotation of the piston through 180 deg. which brings the groove in the plunger opposite the intake port during withdrawal of the piston, and opposite the outlet port while the piston is being pressed in. It is claimed that owing to the absence of mechanical or chemical injury to the blood smaller doses are necessary than when citrated blood is used, 100 to 150 gr. being always sufficient.

La Presse Médicale, 7th Feb., 1923.

Bloch and Hertz recommend the *intrathecal injection of caffein* as a remedy for syncope resulting from spinal anæsthesia.

The authors show that the action of caffein is antagonistic to that of novocain, and for this reacon the administration of this drug before, or together with, the spinal injection of novocain, as a means of preventing the occurrence of syncope proved disappointing. But its employment as a curative when faintness threatened or had developed gave remarkably satisfactory results, and seemed to undoubtedly avert a fatal issue.

The dose of caffein used varied between 25 and 60 cgms. and it was injected intrathecally.

La Presse Médicale, 25th April, 1923.

Blocking of the bulbar centres by novocain in man. R. Soupault.

In 1912 Jean Camus showed that in dogs the bulbar centres could be blocked by the injection of chlorotone through the occipito-atloid membrane, and that the different centres were always affected in the following definite order: that for vomiting; for co-ordination; for respiration; for cardiac control; for vaso-motor control; and that for secretion. In fact he demonstrated that so vital a centre as that for respiration could be functionally paralysed without the mental processes being in any way affected.

Similar experiments were performed in 1921 with stovain and novocain. And now, by chance, the author has met with similar phenomena in man. A patient, aged 33, was given 10 cgrms. novocain by injection in second lumbar space for appendicectomy; anæsthesia was satisfactory, but 40 minutes after injection, when about to be

returned to bed, he became very pale and lay with eyes half closed and with limbs motionless, respiration had ceased, but the pulse remained good. Artificial respiration was kept up for three-quarters of an hour before spontaneous respiration was re-established. During this time the patient was able to move his head, look round, and smile; he also spoke, and when asked why he did not breathe he answered " because there is no air "; he showed resentment when the flagillation of his face was too vigorous, and at the end of half an hour he complained that his ribs were becoming painful; for phonation he depended upon the current of air produced by the artificial respiration.

When breathing recommenced the patient suddenly went into a state of spasm, with opisthotonos, extension of the arms, deviation of the head and eyes to the right, trismus, and grinding of the teeth. This crisis was repeated six times in all. Complete recovery took place.

La Presse Médicale, 19th May, 1923.

Persistent hiccough after operation. Prof. A. LATRONCHE (Poitiers).

A male patient, aged 52, underwent nephrotomy for calculus pyelonephritis, chloroform anæsthesia being used. The operation was perfectly normal, and nothing untoward occurred until the evening following it, when hiccoughs supervened; these were slight at first but soon became intense and frequent, 60 in the minute, rendering sleep impossible and the taking of food very difficult.

All treatment, including morphia, failed to even moderate the spasm, and it was determined to try the effect of ether given hypodermically, as this treatment had been used with success in whooping cough. The hiccough had persisted for seven days when the first injection of ether was administered, 10 ccm. being employed. After half an hour hiccough ceased but returned again during the night. Next day 6 ccm. ether was injected, after this recovery was complete and permanent.

Gazette des Hopitaux, Jan. 27th, 1923.

G. JAUNENEY and J. TAUZIN of Bordeaux, in an interesting article on *surgery in patients with reduced blood pressure,* discuss the problem of choice of anæsthetic method, and sum up their conclusions with the sentence: " Everyone knows that chloroform should be avoided, that spina is in itself a depressant except in minute doses, and that ethyl-chloride, or ether, or better still, local analgesia, should be employed."

Gazette des Hopitaux, April 19th, 1923.

Shock in connection with traumatism of the abdomen. M. G. BLECHMANN.

While at the " front " in 1916 the author was struck with the disproportion existing between the extent of wounds and the severity

of the shock resulting. In the course of his investigations he made observations on the blood pressure in order to find out to what extent this was affected by the trauma of operation on various parts of the body. He found that blood pressure was hardly disturbed by manipulation of the contents of the cranium, or of the chest; but that it was markedly lowered when the limbs or the contents of the abdomen or the pelvis were subjected to operation. In studying the sensitiveness of the peritoneum he observed the change produced by the introduction of ether into the abdomen, a procedure much in favour at the time, and found that a serious fall invariably resulted; in one case the pulse remained imperceptible for 50 seconds. A change in the blood pressure accompanied every surgical manipulation of the peritoneum or viscus. In an appendicectomy performed under local analgesia the pressure fell sharply during various manipulations, but rose again to normal during the intervals of "rest."

Le Progrès Médicale, May 12th, 1923.

Nitrous-oxide in surgery. M. CHIFOLIAU.

In his introductory remarks the author regrets that Parisian surgeons have been slow in adopting this method, which he admits to be more difficult and less convenient than chloroform or ether but which he regards as safer and better for the patient. He deprecates the American and English custom of adding ether or chloroform, as he considers this introduces an unnecessary element of danger; but he also realises the need for patience on the part of the surgeon owing to the fact that relaxation is not complete in many cases until the patient has been unconscious for 15 or 20 minutes. The question of safety is gone into, and reference is made to accidents which have been reported from other clinics, these include instances where death resulted from the gas containing $C.O_2$, in one case to the extent of 18 per cent. In another instance death resulted from hemiplegia following operation for carcinoma of the breast, and the author suggests that the combination of scopolamine and nitrous-oxide has a tendency to produce a marked rise of blood pressure. In conclusion the suggestion is made that this method ought to supersede ether, chloroform, ethyl-chloride, and spinal anæsthesia.

Franco-Belgian Archives of Surgery, March 1923.

General anæsthesia with ethyl chloride-alcohol. RENE REDING (Brussels).

The author feels that owing to faulty technique ethyl chloride has of late been undeservedly neglected, although previously it was the subject of much investigation and work; and that up to the present time opinion is divided as to its innocuity, its indication and its mode of employment.

This article is based on an experience of nearly 5,000 cases in which the drug was mixed with 10 per cent. alcohol so as to raise the

boiling point from 12 deg. to 26 deg., and is administered on an open mask instead of by means of any form of closed apparatus; one essential of the technique to which the author attaches importance is the avoidance of deep narcosis; in fact the pupil is kept small and the cornea sensitive. By this means and by the avoidance of the upright (sitting) position he claims to reduce the danger of syncope to a minimum even in shocked or enfeebled subjects. And he points out that a large proportion of the accidents reported with closed methods have occurred in patients sitting in dentists' chairs.

The author regards the most obvious indication for ethyl chloride to lie in introducing other anæsthetics, such as ether or chloroform, and in short operations; but he refers to cases of more than an hour's duration which, however, he considers to belong to the specialist's province. He advocates its usefulness as a complement to local analgesia.

In the instance of excitable or alcoholic patients, or in the subjects of epilepsy or hysteria, it should not be used without a preliminary injection of scopolamine and morphia. A. L. Flemming.

American Journal of Surgery—Quarterly Supplement of Anæsthesia and Analgesia, April, 1923.

*Some unusual complications of nitrous oxide-oxygen anæsthesia. Ansel M. Caine.

*Blood pressure during surgical operations under general anæsthetics. Morris H. Clark.

Circulatory changes during anæsthesia. John R. Worley.

The physiological effects of nitrous oxide. Neil C. Trew.

Intratracheal insufflation anæsthesia. Mary Kavanagh.

Anæsthesia as a part-time specialty. Moses Salzer.

The anæsthetist on the hospital staff. Chas. H. Sanford.

Oxygen in the peritoneal cavity: with case reports. Wm. S. Bainbridge.

General anæsthesia in submucous and other nasal operations. J. G. Pope.

Some unusual complications of nitrous oxide-oxygen anæsthesia.

The author reports four mishaps: one death immediately following operation of cholecystostomy; another, two months after removal of gall-bladder and appendix; a third, immediately following an appendicectomy; and the fourth case paralysis and blindness for several years.

In summarising his cases he reaches the following conclusions:—

1. If the heart stops because of overdose of nitrous oxide, and under-dose of oxygen, and remains inactive for a minute in the human being, the chances of recovery to normal are not good.

2. Restoration of heart's action and respiration does not mean that the patient is all right, but there are likely to be degenerative changes in the brain that are irreparable.

3. Restoration of consciousness and apparent normality after the heart has stopped under these circumstances does not mean that there is no permanent damage to the brain that will be manifested later.

4. The human brain cannot stand the suspension of circulation and return to normal as can the brain of the dog.

5. The pupils are not a safe guide to saturation, as there are too many exceptions to the rule of dilatation, and these exceptions, when the pupils are depended upon, are too important.

6. The respiration is a much safer guide than the pupil. When respirations slow to almost stopping point, even if deep, it is time to add more oxygen if one is saturating. When the eyeballs turn inward and become fixed, saturation is complete or almost so, independent of the pupil, and oxygen should be added at once. If respirations stop during saturation without any delay at all inflate lungs with oxygen, or with a high percentage of gas and oxygen (25 to 50 per cent. oxygen).

7. Nitrous oxide and oxygen anæsthesia is safe as long as sufficient oxygen is given, but when the oxygen is discontinued for the purpose of saturation in order to secure relaxation, the greatest attention is demanded and the respiration should never be allowed to fail.

Blood pressure during surgical operations under general anæsthesia.

The author classifies the changes in the cardiovascular system during anæsthesia, as (*a*) those due to the anæsthetic, and (*b*) those due to the operative procedure. Under (*a*) he states that chloroform produces slight stimulation during induction and marked depression later. Ether produces marked stimulation during induction and a more gradual onset of the depression period. Nitrous-oxide produces less change in the blood pressure than ether or chloroform.

In this connection is mentioned the pressure-raising property of carbon dioxide.

Under (*b*) he states that factors entering into vasomotor disturbances, are (1) hæmorrhage; (2) trauma; (3) fear; (4) posture during operation; and (5) sudden reduction of cerebral or abdominal pressure (in those cases in which it is previously abnormally high).

"Cerebro-Spinal Pressure Anæsthesia."

Dr. Toshiro Kokubu describes, as reported in the *Japan Medical World* of February 15, 1923, a new method of anæsthesia. He found that "by raising the cerebro-spinal pressure" in the dog there developed just the same stages met with in chloroform or ether anæsthesia, *i.e.*, "a stimulating stage, a somnambulic stage, and a spasmodic stage." In the somnambulic stage there was manifest a general anæsthesia which could be harmlessly continued by regulating the pressure long enough to complete any operation in the dog without pain. The removal of the cerebro-spinal pressure resulted in the "somnambulic" stage passing off.

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SOCIETY REPORTS.

SCOTTISH SOCIETY OF ANÆSTHETISTS.

At the meeting of the Scottish Society of Anæsthetists, held in Glasgow on May 26th, Dr. J. S. Ross communicated two unusual cases of intratracheal anæsthesia. The first was a young man with a rapidly increasing goitre causing marked obstruction of respiration. He was anæsthetised by a mixture, and, as expected, the air-way became completely obstructed at the end of the induction. An intratracheal catheter was introduced by the direct method. It was then found that while air could be freely introduced along the catheter into the chest, the walls of the trachea enclosed the catheter so closely that no reverse current of air could take place. The warning note was given by the increase of pressure in the intratracheal instrument itself causing escape from the safety-valve, examination showing that no air was escaping through the mouth. The anæsthesia was conducted by alternately connecting and disconnecting the apparatus with the catheter. Enucleation of the goitre was effected very rapidly, after which all difficulty disappeared and the man made an excellent recovery.

The second case was one of retro-sternal goitre. In the light of the experience of the previous case it was regarded as possible that a similar difficulty might be experienced in this case, but in actual practice the induction of anæsthesia, the introduction of the tube and the earlier stages of the intratracheal anæsthesia proceeded smoothly. At a later stage of the operation, however, an obstruction of the outflow did actually occur. The operation was one of very considerable difficulty and while the patient left the table alive, death took place some few hours later, apparently from shock. It was also noted that there was a considerable amount of hæmorrhage during the operation.

Dr. Fairlie stated that he had met with two cases, one of epithelioma of the tongue and the other glands in the neck, anæsthetised by the intratracheal method, where the return flow of air had been obstructed. Both patients were of the short-necked type and obstruction was removed simply by keeping forward the jaw. There was no spasm of the glottis.

Dr. Thomson said he had never met any case of obstruction so long as the tube was in position, but to his knowledge two cases had died after the return to bed some considerable time after the tube had been removed.

Dr. J. H. Gibbs mentioned a case which he would have to anæsthetise within the next few days : a very stout lady who had suffered for many years from asthma and who now had a markedly dilated heart with signs of blood pressure. The removal of a septic tooth was absolutely essential to give the patient comfort and a local anæsthetic would, in his judgment, be impossible. He proposed to deal with the case by open ethyl-chloride with oxygen run into the corner of the mouth, and this procedure appeared to be regarded by most members as very suitable.

AMERICAN AND PACIFIC COAST ANÆSTHETISTS.

A Joint Meeting of the American and Pacific Coast Anæsthetists, with the Section on Anæsthesiology of the California State Medical Society, was held at San Francisco, June 22—26.

Among the items on the programme were the following :—

The Effects of Posture on Relaxation Under Anæsthesia. Caroline B. Palmer.

Reversing Anæsthetic By-Effects through Selective Medication. Lorulli A. Rethwilm.

Spinal Anæsthesia for Upper Abdominal Operations. L. L. Stanley.

Sacral Anæsthesia for Recto-Colonic Operations. A. J. Murietta.

Spinal Anæsthesia in Obstetrics and Cæsarean Section. H. T. Cooke.

Anæsthesia for Oral Surgery with special reference to the Dangers and Advantages of the Beck-Mueller Apparatus. Walter R. Crane.

General Anæsthesia in Nose and Throat Surgery Hypodermically Administered. Isaac H. Jones.

Pure Nitrous Oxide Oxygen for Oral Surgery in the Upright Posture. E. I. McKesson.

Selective Anæsthesia for Plastic Surgery of the Mouth and Jaw. Frank Chandler.

Keeping Anæsthetic Records and What They Show. John S. Lundy.

Medico-Legal and Obstetrical Considerations of Scopolamine Anæsthesia. R. E. House.

Ethylene-Oxygen Anæsthesia : Research and Clinical Considerations. A. B. Luckhardt and Isabella C. Herb.

Pre- and Post-Operative Care of Patients from the Anæsthetist's View-point. R. F. Hastreiter.

Anæmia in Relation to Surgery and Anæsthesia. W. H. Gilbert.
Evaluation of Cardiac Reserve. Alfred Friedlander.
Heart Complications in Anæsthesia. J. M. Wilson.
Shock from the Anæsthetist's View-point. Neil C. Trew.
Anæsthesia for Hazardous Brain Surgery Risks. Dorothy A. Wood.
The Goitre Risk and a Simplified Technique of Local Anæsthesia. John Hunt.
Positive Pressure for Thoracic Surgery with Nitrous-Oxide-Oxygen Anæsthesia. Sterling Bunnell.

Anæsthetic Clinics were held at Lane Hospital, Stanford University, and at the University of California. Laboratory demonstrations were given at the University of California Medical College.

CANADIAN SOCIETY OF ANÆSTHETISTS.

At the Third Annual Meeting of the Canadian Society of Anæsthetists held at Montreal, June 12—14, the following papers were amongst those read :—

Further Studies in the Pharmacological Effect of Impurities in Anæsthetic Ethers. Walter L. Mendenhall and A. W. Rowe.
Observations upon some Reflex Effects of Ether. M. S. Dooley.
Diabetic Coma in Relation to Surgery and Anæsthesia. F. G.Banting.
The Anæsthesia Problem in Exophthalmic Goitre. Don. A. Warren.
Preliminary Medication. Robert Hammond.
Psychology in its relation to the Anæsthetist. John J. Buettner.
Shock Prophylaxis. Charles J. Wells.
Fatty Degeneration of the Liver following Ether Anæsthesia. Wm. B. Howell.
Effects of Ether Anæsthesia on Afferent Paths in Decerebrate Animals. A. Forbes and R. H. Miller.
Nitrous-Oxide-Oxygen for Cystoscopy. G. M. Geldert.
Carbon Dioxide Administration after Anæsthesia. James R. White.

Anæsthesia Clinics were held in the Montreal Hospitals, and Laboratory Demonstrations were given in the new McGill University Buildings.

" The verdict of those best qualified to judge assigned the credit of the ether discovery to Morton. Yet the man went unrewarded,—his life apparently a failure, his practice destroyed, his family scattered, ruined, and wretched, his health broken, and premature death, a happy release from a harassed and miserable existence."—*Medicine in America*, Mumford.

DIRECTORY OF ANÆSTHETIC SOCIETIES.

Section of Anæsthetics, Royal Society of Medicine. Council: President—A. L. Flemming, M.B.; Vice-President—H. G. Shirley, C.M.G., M.D.; Hon. Secs.—G. Ramsey Phillips, Charles F. Hadfield, M.D. Other Members of Council—H. P. Crampton, M.D., Ashley S. Daly, W. Howard Jones, M.B., C. J. Loosely, H. R. Phillips, M.D., F. S. Rood, M.B. Representative on Library Committee—Frances May Dickinson Berry, M.D.; Representative on Editorial Committee—J. Blomfield, O.B.E., M.D.

There will be a meeting at Birmingham on Saturday, Dec. 1st, 1923.

The *Anæsthetic Section* of the *British Medical Association.* Annual Meeting at Portsmouth, Thursday, July 26th.

Papers: Dr. Harold Sington (London), Anæsthesia for Children; Dr. Arthur L. Flemming (Bristol), Fatalities from Anæsthetics; Dr. H. E. G. Boyle (London), Paper and Demonstration of Apparatus for Administration of Gas, C.E., and Oxygen.

Officers of Section: President—W. J. Essery, C.V.O., M.B.; Vice-Presidents—H. E. G. Boyle, O.B.E., M.R.C.S., L.R.C.P., Wm. Carling, M.B., B.Ch., C. H. Mott, M.R.C.S., L.R.C.P.; Hon. Secs.—R. H. Emmett, M.A., M.R.C.S., L.R.C.P., H. R. Philipps, M.D.

On Friday, July 27th, before the Section on Surgery, there will be a discussion: Anæsthetics from the Surgeon's Point of View, to be opened by Mr. Wilfrid Trotter, followed by Sir Wm. de Courcy Wheeler and Drs. A. L. Fleming, J. Blomfield, and A. E. Boyd.

Scottish Society of Anæsthetists. President—Dr. J. H. Gibbs, Edinburgh; Vice-President—Dr. H. P. Fairlie, Glasgow; Hon. Sec. and Treasurer—Dr. J. S. Ross, Edinburgh; Executive—Drs. H. Jones, D. Lamb, Alex. Ogston, and A. Mills.

One ordinary meeting upon some Saturday in May.

Canadian Society of Anæsthetists. 100 Members. President—David H. Arnott, M.D.; Secretary—Wesley Bourne, M.D, 34, St. Mark Street, Montreal.

American Association of Anæsthetists. 1,200 members. Secretary and Treasurer—F. H. McMechan, M.D., Lake Shore Rd., Avon Lake, Ohio.

National Anæsthesia Research Society. President—E. I. McKesson, M.D., Toledo, Ohio.

A second Congress in joint meeting with the Inter-State- and Mid-Western Anæsthetists, will be held at Chicago, Oct. 22—24, 1923, during the Clinical Congress of Surgeons.

Pacific Coast Anæsthetists. Secretary-Treasurer—Eleanor Seymour, M.D., 845, West 10th Street, Los Angeles, Cala.

Southern Association. Secretary-Treasurer—W. Hamilton Long, M.D., Louisville, Ky.

Second annual meeting at Washington, D.C., Nov. 12—14, 1923, conjointly with the Southern Medical Association.

Associated Anæsthetists. General Secretary—F. H. McMechan, M.D., Lake Shore Rd., Avon Lake, Ohio.

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JOSEPH THOMAS CLOVER, 1825—1882: A PIONEER IN ANÆSTHESIA.

By Dudley Wilmot Buxton, M.D., B.S., M.R.C.P.,

Consulting Anæsthetist to University College Hospital, the National Hospital for Paralysis and Epilepsy, and Physician Anæsthetist to the West Herts Hospital, Hemel Hempstead.

IN the original edition of the "Dictionary of National Biography" no room was found for this man, who of all others placed upon a scientific basis the methods of employing ether. Curiously enough, however, we read in this dictionary of another Joseph Clover (1725—1811) who also came from Norfolk. This man was a farrier, the son of a blacksmith, and he did a certain amount of useful work on the diseases peculiar to horses. Such is fame!

The average person, if asked who was Clover, would reply, "The man who made the inhaler." However, Clover did far more than this, for, as I hope to show, it is to him that we owe the inception of our present knowledge of ether administration. That this man, together with his work, is not better known, is probably due to the fact that he wrote little and sought the limelight of professional gatherings not at all.

I was privileged, through the kindness of Mrs. Clover, his widow, and Mr. Martin Clover, his son, to look through the memoranda and sketches which Clover left behind him. Although these showed the ingenuity and meticulous care with which he worked at the problems of ether administration, yet unfortunately they were unsuited for publication. They revealed the atmosphere in which he laboured, but failed to afford the detail requisite for a memoir such as I at that time hoped to produce.

The story of Joseph Clover's useful life is soon told. Born in 1825 at Aylsham, in Norfolk, he received his education in the Grey Friars' School at Norwich, and in due course was entered as a pupil at the Norfolk and Norwich Hospital, a place ranking high among the provincial hospitals, known to many as the hospital in which Sir Peter Eade and Mr. William Cadge, the lithotomist, did such valuable clinical work. In my early days I held a post there, and, looking back, I appreciate what valuable lessons were to be learnt by a pupil attached to it.

In 1844 Clover passed to University College Hospital, and in due course became house surgeon to Mr. Morton and to Mr. Syme, then a surgeon attached to that school. When Syme migrated to Edinburgh he offered to Clover the post of his assistant, but the latter preferred to remain in London, and undertook the responsible duties of Resident Medical Officer to the University College Hospital, a post which he held for five years. It will be seen from these dates that he was a fellow student with Lord Lister, and saw the surgical work of Syme and Liston, and was present on the historic occasion when the last-named surgeon operated upon a patient who had been rendered anæsthetic by the inhalation of ether; this was the first major operation performed in London, the patient being anæsthetized. This took place in the old operation theatre of University College Hospital on December 21, 1846.

As Resident Medical Officer it was Clover's duty to give anæsthetics to patients, and thus his attention was early focussed upon this branch of his profession. In 1853 he became a Fellow of the Royal College of Surgeons, and decided to practice as a surgeon, for which art he evinced special aptitude.

All his life Clover had been very delicate; repeatedly he had been obliged to rest from his studies for long periods, and when practice began to come to him, as it did from the commencement of his surgical career, he was regretfully forced to recognize that the arduous life of a surgeon was not for him. Perhaps his personal loss was his profession's gain, since in his day surgeons were plentiful, anæsthetists, as such, were unknown, save and except that father of the craft—Dr.

Snow. Clover decided to adopt the career of an anæsthetist, and at once began to consider the problems connected with this line of work and to improve the crude methods then in vogue.

The introduction of ether as an anæsthetic in 1846 was followed in the succeeding year by Simpson's dramatic announcement of the satisfactory employment "of a new anæsthetic as a substitute for sulphuric ether," and for the nonce the last-named agent fell out of favour. The following years revealed the dangers incident to the use of chloroform by unscientific methods, and in spite of Dr. Snow's clear teaching that such dangers were rather those of method than inherent in the drug itself, popular and professional opinion became unsettled and distrustful as to what drug, if any, should be used for the production of anæsthesia. The Royal Medical and Chirurgical Society of London, now the Royal Society of Medicine, appointed a committee to investigate the rival claims of chloroform and ether. Leading physicians, surgeons and one dental surgeon served upon the Committee, and Mr. Clover was associated with it as an expert, and superintended the large number of valuable experiments which were carried out under its auspices. The Report was published in 1864 and marks the commencement of Clover's serious work upon the best methods of anæsthetization. After rehearsing the data upon which its conclusions were based the Report summarized its findings somewhat as follows: Chloroform, the Committee contended, was more dangerous than ether, its danger being due to excessive or irregular dosage. "It is," indicates the Report, "as desirable to measure accurately the strength of the vapour (of chloroform) as to weigh the dose of a medicinal agent administered by the mouth." It continues: "The only apparatus at present known to the Committee which fulfils the necessary conditions is that contrived by Mr. Clover. . . . ." This statement fails to do justice to Dr. Snow, whose apparatus was a definite attempt to supply a truly dosimetric inhaler, which enabled the administration of known strengths of chloroform vapour. However, Clover's bag and mixer were certainly more accurate, as by their use the vapour offered to the patient was always of a definite strength and so uninfluenced by the rate of

respiration and amplitude of the pulmonary ventilation. The Committee, while admitting the greater safety of ether, considered that it was an undesirable anæsthetic as its employment took too long and its effects were too uncertain and unreliable.

This conclusion was inevitable as the methods of etherization were wholly unsound. The apparatus used was of two types. In one a flask containing pieces of sponge was connected with a tubulure ending in a cap which either covered the nose and mouth or merely the mouth, air being admitted into the flask or the face-piece; in the other a large mask, such as has come down to us as Rendle's mask, into the summit of which ether was poured from time to time and was soaked up by a pad of cotton wool. Various forms, from a rolled towel to Morgan's hat-like inhaler, were adopted, but all lacked precision, and their use often caused furious excitement but poor anæsthesia.

Thus the two problems for solution which confronted Clover were (1) how to speed up the induction of anæsthesia when ether was used, and (2) how to regulate the strength of the vapour according to the requirements of the patient and the necessities of the operation in progress. Clover recognized that the gravamen was not to prove which anæsthetic was dangerous, but was in fact how to standardize methods. It is curious how frequently the all-important question of method has been neglected. One finds this throughout the history of anæsthesia; it crops up in the various commissions and reports of committees, and recently in a discussion on the relative safety of chloroform and ether which appeared in our journals but few of the disputants dealt with method while they advocated one or other of the dominant anæsthetics. Clover's ingenuity and knowledge of physics found the task he set himself at once stimulating and congenial.

In 1862 he introduced his regulating chloroform inhaler, to which a reference has been made, but he never liked the anæsthetic nor adopted the mixtures, A.C.E., the two mixtures C_2E_4 and C_2E_3 invented by Dr. George Harley, and described before the Royal Society. Nitrous oxide gas introduced into this country in 1866 as an anæsthetic, offered Clover what he wanted, and led him to advocate and perfect

the method of inducing anæsthesia by a sequence of this gas and ether. The apparatus was invented and described in 1876. By it an induction period of from one-and-a-half to two minutes was provided for, and a continuous inhalation was achieved, first nitrous oxide then this gas mixed with ether vapour in advancing strength, and finally ether vapour with air.

The introduction by Dr. Ormsby, of Dublin, of his ether inhaler provided an apparatus half-way between the older and crude inhalers and Clover's closed method. This inhaler, however, appealed to some surgeons, and when Clover published his gas and ether method an alternative plan was launched upon the profession. This was the use of gas from an ordinary gas-bag followed when unconsciousness was assured, by ether given in full strength from the Ormsby inhaler. This method lacked the precision of Clover's plan, and failed to provide a continuous gradually increasing strength of ether vapour, such as Clover shrewdly recognized was the ideal to which the anæsthetist should direct his efforts.

The apparatus which Clover devised, as is well known, consists of a metal receiver for the ether surrounded by a water-jacket. This jacket in subsequent models was made smaller, and the thermometer at first inserted was omitted. From the receiver a tubulure traverses a rubber bag, the latter being similar, although smaller, than the gas-bag then in use. Into the bag nitrous oxide could be made to enter. At the distal end the regulating mechanism made of metal received the far end of the tubulure and the opening into the gas-bag. By this, entry of gas and ether in requisite proportions was effected, and it also gave attachment to the rubber face-piece. Clover devoted much time and experiment to the construction of the tubulure and face-piece. He found that, provided the lumen of the passage from the face-piece to the ether supply was at least as large as the lumen of the trachea, no difficulty or discomfort in breathing could or did take place. Indeed, when it was made larger the "dead space" was increased and aerial stasis was favoured. He elaborated the face-piece with great care, taking moulds of various faces, and by the use of air cushions the mask was made to fit accurately. This was a great advance upon the mouth or oro-nasal cap previously employed, as breathing into the mask is easier

and less laborious than the aspiration from the mouth cap through a long tube. The actual area of respiration in this apparatus is that provided by the mask, so that no question of dyspnœa arises provided the mask is of the appropriate size. These details have been dwelt upon because they afford a glimpse of the grasp Clover had of the necessities of the technique he was elaborating and of the ingenuity he brought to bear upon his task.

As nitrous oxide was not within access of many practitioners, Clover set to work upon an ether inhaler which would be used for ether alone. This was his "portable regulating ether inhaler," the best known of his apparatus, and one which has been variously modified, but not in every case improved by succeeding generations of anæsthetists.

But Clover was not only a mechanic, draughtsman and inventor, he possessed a sound knowledge of the theory of the uses of anæsthetics which are revealed in his writings. Unfortunately, his published papers are few. One point may be cited in support of this statement. As soon as Clover's apparatus came into general use a certain school of ether enthusiasts, the most prominent of whom was the late Mr. Pridgin Teale, of Leeds, taught that air exclusion was an essential in inducing anæsthesia by ether, and that cyanosis, so far from being harmful, was an essential part of the technique. To this Clover refused to subscribe, and taught that cyanosis must be avoided by lifting the inhaler off the face every sixth or eighth respiration so that one complete expiration followed by one complete inspiration of pure air could be obtained. The fact that carbon dioxide is a mild anæsthetic is not overlooked in the above statement. It is not the inhalation of the gas which is responsible for the obnoxious cyanosis, it is the undesirable delimitation of oxygen which makes for danger and increases the unpleasant after effects, while it gives rise to the miserable feeling of asphyxiation, such as obtained in the old days. Some years ago the present writer examined a large number of cases, and found that whenever cyanosis was allowed to develop a minor complication always arose, while the recovery from anæsthesia was invariably associated with headache, nausea or vomiting, conditions seldom evinced by patients who were not overdosed

or deprived of sufficient oxygen. The apparatus which Clover produced are the prototypes of succeeding ones, and his teaching is the basis of much, if not all, that we now adopt in our lectures, although the source of inspiration is at times overlooked.

It is true that our armamentarium is increased, for we have the additions enabling us to use endo-tracheal, intravenous, colonic, warmed ether vapour and other methods. Clover designed, but seldom employed, nasal tubes through which patients could inhale. Ellis' method of the use of mixed vapours and the semi-open ether methods which were soon evolved did not come within Clover's purview and so call for no detailed notice. Ethyl chloride, although introduced as an anæsthetic in 1848 by Heyfelder, does not appear to have interested Clover, although he adopted the use of ethylene dichloride and employed it in nearly two thousand cases. He refers, but guardedly, to ethyl bromide, and he did not personally adopt its use.

Clover, who was unofficially attached to University College Hospital, delivered lectures there at wide intervals. These gave no systematic teaching, but were made the avenue by which he introduced fresh methods or detailed the use of newly-adopted anæsthetics. His writings, scattered through medical journals were few, and chiefly in the form of letters to the editor. He, with the late Mr. G. H. Bailey, contributed the article on Anæsthetics to Quain's "Dictionary of Medicine."

As has been mentioned, Clover was first a surgeon and afterwards an anæsthetist. Surgery owes to his genius useful surgical apparatus, notably Clover's bottle for exhausting débris after lithotomy, in which he adopted Sir F. Crampton's suction method, and Clover's crutch, so valuable when the patient is placed in the lithotomy position.

It was said of Clover, "His end was quite in keeping with his whole life—gentle, amiable, uncomplaining to the last. The world wants one true man since he was taken away."

So Clover passed in 1882; he built for us, his pupils, a great structure, he worked as we should work, for the good of mankind, for the assuaging of suffering and the advance of true science. Let us do him honour and emulate his efforts.

PAINLESS CHILDBIRTH BY SYNERGISTIC METHODS.

[Second Paper.]

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and
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IN our preliminary paper[1] we outlined the conditions by which it is proposed to secure painless labour. One of these conditions is to modify or stop the procedure whenever mother or child appeared to be in danger. The colonic administration of some of the drugs is selected, as the parturient woman is usually prepared for this method. We cited 64 cases, but in that series one case of morphin-apnœa (not fatal) was noted, so now morphin is not given routinely, but only in selected cases and by hypodermic, and then only in the early stages. At present reliance is placed upon the synergism of ether and magnesium sulphate for the major effect, although other drugs are used. The magnesium sulphate is given by hypodermic in a 50 per cent. solution,[2] and morphin is added when indicated. The magnesium sulphate is repeated when necessary and usually without morphin. Cowan states that " In all cases the cervix has dilated with or without the addition of morphin, but dilatation has progressed faster with the thick tough cervix when morphin has been given with the magnesium sulphate. In excitable patients, and where you expect a long labour, or in cases just cited above, dissolve $\frac{1}{4}$ grain of morphin in the first hypodermic of magnesium sulphate. The ether, dissolved in one-third the amount of olive oil, is given by rectum but not to the extent as used by Thaler and Hubel.[3] The ether is not repeated, as it is retained in over 98 per cent. of the cases.

1. *British Journal of Anæsthesia,* Vol i, July 1, 1923.
2. *Amer. Journ. Med. Sciences,* March 1923, p. 431.
3. *Zentralblatt für Gynäcologie,* Leipsic 47, 337—384, March 3, 1923.

The following is the usual procedure:—Hypodermic magnesium sulphate (chemically pure) 2 cc. of a 50 per cent. solution (with or without morphin) is given when the cervix is dilated about two fingers, and repeated when necessary—one to three times. One to two hours later, a rectal instillation of—

Quin. H Br.	10 Grains
Alcohol	1 Dram
Ether	3 Ounces
Olive oil	1 Ounce

The instillation is given when the cervix is dilated two and a half to three and a half fingers, depending on the frequency of pains and severity.

This present technique is far superior to anything we have heretofore used, and with the last 40 patients has been changed only in minor details.

Normal cases—not too far advanced—are selected as otherwise the issue would be obscured. The usual method is as follows: Place patient in Sims position and insert small catheter filled with olive oil (to exclude air) three or four inches in rectum. A small glass funnel is attached to free end of catheter and is held just above the hips—the mixture is now poured in slowly. Pressure is made during pains with a crumpled towel held in the hand pressed firmly against the perineum to prevent expulsion.

Cowan improvised a technique for parturient women for which he cannot be given too much credit, and which is vastly superior to the funnel gravity method just described inasmuch as it takes less times, is less likely to be expelled, and by forcing the mixture into the upper portion of the rectum it is more quickly absorbed. It converts an uncertain procedure into a certainty and is as follows:—

Cowan's technique:—Connect catheter with large syringe holding the mixture, instil slowly and with gentle pressure force the fluid between pains, the whole amount to be instilled between two and three pains. During pains pressure upon the perineum as heretofore.

This procedure should not take over five minutes, but pressure on perineum should continue for fifteen minutes

more. The advantages of this technique are obvious. The descending head tends to occlude the rectum and make instillation by gravity long and difficult, but with a syringe we can force a considerable part of the fluid beyond the head into the upper portion of the rectum. With this method the whole amount of fluid is retained in over 95 per cent. of the cases. Relief of pain is noticed in from 15 to 45 minutes, the pain-free period lasting from four to five hours.

Results. The effect of the synergists upon the nervous system is exciting in 3 per cent. of the cases, unchanged in 3 per cent., and sedative in 94 per cent.

It was thought this excitement was due to the alcohol, which is now reduced from four to one dram. There has not been a sufficient number of cases since to determine the effect of this reduction.

The deliveries are 4 per cent. with forceps, and 96 per cent. normal.

Occipito-posterior positions rotate in about the same proportion with as without the synergists.

Comparatively, post partum hæmorrhage is unchanged.

Labour is increased in time in 4 per cent, and progresses uneventfully in 96 per cent. of the cases.

Nausea occurs in 2 per cent., thirst in 4 per cent., vomiting 8 per cent., and normal and uneventful in 86 per cent. of the cases.

Pain is increased in 1 per cent, unchanged in 3 per cent., and modified or painless in 96 per cent. of all cases.

Condition of Baby. Asphyxia (not fatal) 1 per cent, apnœic 2 per cent., and crying 97 per cent.

Case reports.—From service on Fifth Floor (O'Reagan).

With the present technique pain is materially decreased in all cases and in a few entirely eliminated; and labour is not, as a rule, delayed or prolonged any more than it would be if the drugs were not used.

From service on Sixth Floor (Cowan).

July 13th, 1923. Mrs. R. W., multipara.

All previous labours normal. Severe pain every two or three minutes, and lasting for one minute. Cervix two fingers

dilated, thick and soft. Ampoule of magnesium sulphate given at time of instillation. Distinct sedative effect lasting four and a half hours. Patient stated she felt very little pain, but was conscious that contractions were continuing. Second ampoule of magnesium sulphate given but no decided effect. Patient had fairly strong pains for two and a half hours before delivery. Baby crying when delivered.

Conclusion. Morphin should have been given with first ampoule of magnesium sulphate, but instillation should have been delayed until cervix was dilated to about three fingers.

July 31st, 1923. Para-1, Mrs. I. V.—Coloured.

Moderate-sized woman, who co-operated well. Strong pains every two minutes lasting 15 seconds. Cervix three fingers dilated, soft, thin. Hypodermic 2 cc. magnesium sulphate 25 per cent. solution, and at same time instillation was given, syringe method. Whole amount retained. Distinct sedative effect. Pains practically subsided, but patient felt contractions continuing. Patient dilated fully with the synergists. No nausea or vomiting. Patient delivered one and a half hours after instillation. As head was passing over perineum patient had considerable pain for five minutes. Excited. First degree laceration. No chloroform given except for repair. Baby crying when delivered.

Conclusion. This patient should have had morphin with first hypodermic, and also chloroform during last five minutes of delivery.

July 14th, 1923. Mrs. L. S., para-1.

Medium size, pains every five minutes, fairly strong and lasting 15 to 30 seconds. Cervix three and a half fingers dilated, soft, but not obliterated. Hypodermic and instillation given at same time. Sedative effect lasted three and twenty-five minutes, when hypodermic was repeated with good synergistic effect. Thirst and vomiting present. Cervix dilated from three and a half fingers to full. Delivery was spontaneous, four hours and thirty-seven minutes after instillation, and with only one hard pain while head was passing over perineum. No laceration. No chloroform used. Patient

drowsy for one hour following delivery. Child crying and normal.

July 22nd, 1923. Mrs. C. C., para-1.

Moderate-sized woman, having pains every five minutes and lasting 15 seconds. One ampoule of magnesium sulphate 2 cc. 25 per cent. solution with $\frac{1}{6}$ grain of morphin was given when cervix was dilated two to two and a half fingers. Instillation given by syringe method when cervix was three fingers dilated—soft, but not obliterated. Whole amount retained. Two and a half hours afterwards hypodermic magnesium sulphate 25 per cent. solution. Patient co-operated well. Sedative effect marked, as evidenced by sleepy appearance and little pain, but patient stated she felt contractions continuing. Some nausea and slight vomiting. Cervix dilated fully. L.O.P. position rotated to L.O.A. and was delivered spontaneously about four and a half hours after instillation. Patient had severe pains during last five or ten minutes. First degree laceration.

Conclusion. A very good result, but this patient should have had chloroform the last five minutes while head was passing over perineum.

July 18th, 1923. Mrs. V. H., primipara.

Large, heavy type of patient, having hard pains every minute, very noisy and complaining especially of backache, which was almost unbearable. Cervix dilated two fingers. A hypodermic of morphin sulph. gr. $\frac{1}{6}$, dissolved in 2 cc. of a 25 per cent. solution of magnesium sulphate, given. The second ampoule of magnesium sulphate without morphin was given one hour later. (Some relief, but patient still complains of pain.)

Rectal instillation given one and a half hours after *first* hypodermic—cervix thin and dilated three fingers. At first slight irritating effect—sedative effect beginning 15 minutes after instillation. Backache ceased immediately, pains less severe, but patient was unconscious—contractions were still going on. Cervix dilated fully in 45 minutes and delivery in one hour and 45 minutes after instillation. Baby crying and normal in every way. No anæsthetic used while head was

passing over perineum, and delivery was accomplished practically with no pain—no laceration. The analgesic effect was still present after delivery as evidenced by piercing perineum with towel clip without causing pain. No post partum hæmorrhage.

Conclusion. No such ideal results can be expected in all cases.

SUMMARY.

1. Labour is not delayed, for while the pain is relieved the contractions continue in over 98 per cent. of the cases.

2. The condition of the baby is not affected by the medication.

3. Ether administered colonically to the mother is safer from the offspring's standpoint than is sufficient morphin to produce the same effect.

The monument to Morton, erected by the State of Connecticut and the City of Hartford in Mount Auburn Cemetery, bears the following inscription :—

WILLIAM THOMAS GRIEN MORTON,

Inventor and Revealor of Anæsthetic Inhalation, Before Whom in all Time Surgery was Agony, By Whom Pain in Surgery was Averted and Annulled, Since Whom Science has Control of Pain.

Close watch the flowing crimson tide,
With touch upon the pulse applied
To know its meaning well.
If it go fast, if it go slow
Its number, rhythm, tension know,
For they the life gauge tell.

The hues that mantle on the cheek
Conditions of the blood bespeak,
Observe with anxious care.
Then ever keep the mind at work,
Nor let it tire nor let it shirk,
Nor wander otherwhere.

Note well sleep's elder brother,—Death
Awaits the shallow faltering breath.
Beware the open pupil, still;
Beware the muscles that are lax,
The jaw that lags or tumbles back,
Such symptoms bode but ill.

That man is blind as he can be
Who seeing all there is to see,
Observing does not understand.
Then keep the mind alert and keen,
Quickly decide on what is seen,
All things hold firm in hand.

Be not o'er timid nor o'er bold,
As coward or as dolt enrolled.
Maintain an even sleep,
The surgeon then will give you praise,
The patient too will bless your days,
And you your job will keep!

If things go wrong, be calm and cool,
Be rattled not, nor play the fool,
Work on a well-laid plan.
And in the end have sand and sense
To ask a proper recompense,
Be reckoned as a man!

F. D. BULLARD, Los Angeles, Cala.

In the *Am. Journal Surgery*, Anæsthetic Supplement.

SOME SPECIAL METHODS OF ADMINISTERING ANÆSTHETICS.

By H. P. Fairlie, M.D.

IN choosing the above subject I have in view some of the more recently introduced methods of administering anæsthetics, methods which require more elaborate apparatus and technique than those in common use. I have been moved to do so by reason of frequent criticisms of these newer methods. Many men question the value of all the additional paraphernalia which they involve, and cite the drop bottle and a piece of lint as being good enough for them. Far be it from me to decry simplicity in administration. The drop method, with its modest requirements in the way of apparatus, holds the field as the best for routine use, and so far no more generally satisfactory method has appeared to dispute its claim. At the same time, the specialist in anæsthesia would be foolish to ignore the other means at his disposal. Neither is it my intention to uphold all the complicated and cumbersome methods which, during the past twenty years, have been hailed as the last word in anæsthesia. Some of them, after a brief existence, have found a place on the shelf. There are to-day, for instance, very few exponents of intravenous anæsthesia. The complicated apparatus, prolonged preparation of sterile solutions, and intricate technique which it involved have combined to lead to its disuse in face of more trustworthy competitors.

There are, however, a number of special methods which have established their claim to a definite place in anæsthesia, and with four of those I wish to deal briefly. They are—Gas and Oxygen, Intra-tracheal, Spinal and Rectal Anæsthesiæ. All of them require considerable elaboration of apparatus or technique, or both, and yet each possesses a strong claim for employment in its own special field. My purpose in writing this paper is to outline the special cases in which I prefer to use each of those anæsthetics, and to give my reasons for the choice, with a few illustrative cases.

Gas and Oxygen Anæsthesia.

I ought to preface my remarks on this anæsthetic by stating quite frankly that I rarely use it alone. In nearly every case I prefer the patient to have a preliminary narcotic, morphia or heroin given if possible in two doses. In many cases I accompany it with small quantities of ether, and, in abdominal operations, its best results are obtained in combination with local anæsthetics, the surgeon using a weak novocaine solution as he goes along. The objection is frequently made that such an anæsthesia, especially if ether be used, is not entitled to be called "gas and oxygen" anæsthesia. Strictly speaking, the criticism is justified, but with preliminary narcotics and local anæsthesia, if need be, the quantity of ether used is so small as not seriously to complicate matters. It is quite certain that, using the minimum quantity of ether, the resulting anæsthesia is much more satisfactory as regards after effects than a straight ether anæsthesia.

As regards its scope, it would probably be used as a routine method were it not for one great disadvantage, viz., its cost. For an administration of any length this factor seriously militates against its more general employment.

The classes of special cases in which I find it of value are three—(1) patients suffering from shock, (2) patients debilitated from any cause, where the administration of any anæsthetic presents a problem, and (3) patients who have had violent sickness after former ether or chloroform administrations.

Cases.

(1) As an example of the first class, I might cite the case of a male patient, aged 18, who had a sarcoma of the femur, disarticulation at the hip. Morphia $\frac{1}{4}$ grain was administered one hour before operation. Induction with gas-oxygen and ether. Ether turned off at five minutes and not required thereafter. Satisfactory anæsthesia throughout. Although the operation, lasting 55 minutes, entailed a considerable amount of shock the patient's condition never gave any cause for anxiety. Recovery was uninterrupted and unaccompanied by sickness.

(2) A woman of 75, frail and thin. Operation for removal of gall-stones from gall bladder and common duct; gall bladder drained. Heroin 1/12 was given four hours and one hour before operation. Ether was used for two minutes during induction and three times subsequently for one minute each time. Novocaine ½ per cent. solution was injected locally in subcutaneous and deeper tissues by the surgeon at commencement of operation. Anæsthesia lasted for 75 minutes, and the operation, despite the feebleness of the patient, caused little disturbance. The patient made a good recovery, with slight sickness during the first twelve hours.

(3) A man of 48, in good condition, who had twice previously had anæsthetics and was violently sick after both. Operation for left inguinal hernia and varicose veins, lasting 75 minutes. Heroin 1/12 was given three hours and one hour before. Ether for six minutes at commencement and three times subsequently for half a minute periods during the first half hour, then not required further. Uneventful anæsthesia and recovery without vomiting. In this case the fear of the after sickness and consequent discomfort was sufficient to make the patient very nervous about the anæsthesia, and the complete freedom from it was all the more appreciated. It is only fair, however, to state that in other similar cases gas-oxygen has not proved so successful, a few patients having had troublesome after sickness.

Intra-tracheal Anæsthesia.

Chloroform, ether or mixtures may be used by this method. The apparatus I used for chloroform (*Glasgow Medical Journal*, Dec. 1917) did not prove completely satisfactory, and latterly I have been using ether exclusively. There is now, however, a very good apparatus on the market which allows of chloroform, ether or mixtures being administered, with accurate percentage control, its only disadvantage being its bulk.

Again the cases may be divided into three classes :—

(1) The surgery of the lungs.

(2) Operations about the neck where there is pressure from tumour, or the probability of pressure during the operation, *e.g.*, goitres, glands, branchial cysts, etc.

(3) Operations in the mouth, nose or about the face, where advantage is obtained (*a*) from the return stream of air keeping the airway unobstructed by blood, and (*b*) from the anæsthetist being able to keep away from the field of operation.

Of class (1) I am not qualified to speak, having only twice had the opportunity of testing this method in lung operations. Both were cases of bronchiectasis in children. The first died from drowning in his own secretion before the tracheal tube could be passed. The second was successful.

(2) A woman of 22, thin and rather nervous, with an exophthalmic goitre. In such cases the anæsthesia is rendered very much easier, and the anæsthetist's anxiety very considerably relieved, by using intra-tracheal anæsthesia. Induction by open ether and a No. 22 catheter passed through the laryngoscope. The resulting anæsthesia was excellent, lasting for 90 minutes, and allowing of the manipulation of the thyroid involving traction and pressure on the trachea. There was free hæmorrhage. The patient made a good recovery.

Again, in this class the administrator is relieved of worry in a way that no other method can achieve. As an example, I will quote the case of a man of 30, who had a plastic operation for restoration of the nose destroyed by lupus. The operation was performed in two stages, the first lasting 55 minutes and the second three hours. In both the anæsthesia was satisfactory, the airway being kept unobstructed by blood, and I being enabled to keep clear of the surgeon and assistants.

Spinal Anæsthesia.

My preference for this anæsthesia is in deep intra-pelvic operations where the very complete relaxation it produces is of great value, while the results are obtained without high injection, and shock is reduced. The operation, *par excellence*, where I find it valuable is a Wertheim. In such operation I generally use gas-oxygen in combination, owing to the discomfort of the Trendelenburg position to a conscious patient. The following is a record of such a case:—

A girl of 19, with a cancer of the cervix. Morphia $\frac{1}{4}$ and atropine 1/100 one hour before operation. Injection of $1\frac{1}{2}$ cc. of Barker's heavy stovaine solution at first lumbar interspace,

then Trendelenburg position for three minutes. Anæsthesia to two inches above umbilicus in five minutes. Gas-oxygen with ether started at six minutes, and ether stopped at nine minutes. Trendelenburg position again at 15 minutes when the operation was commenced, lasting for one hour. During that time relaxation was complete, although general anæsthesia was maintained at a minimum, and twice slight retching occurred. The patient's general condition was good throughout, and recovery till time of departure from hospital was uninterrupted. Sickness only occurred once after operation.

In my series of spinal cases I have seen none of the severe sequelæ which occur. Some patients have complained of headache for a few days, but none have developed paralytic symptoms. This may be due to the fact that I have always injected low, in the lumbar region. In one case a very grave cardiac collapse happened. A man of 65, in good condition, was to be operated on for an enlarged prostate. He had $\frac{1}{4}$ grain morphia one hour beforehand, $1\frac{1}{2}$ cc. of Barker's heavy solution injected at the 2nd lumbar interspace, and patient placed in the Trendelenburg position for two minutes. Anæsthesia extended up to the umbilicus at four minutes. At six minutes gas-oxygen commenced, and ether added at seven minutes. At ten minutes, while the skin was being prepared for incision, the patient suddenly collapsed, becoming almost pulseless, pale and clammy, and stopped breathing. He was put in the Trendelenburg position at once, oxygen administered and artificial respiration commenced. Recovery, up to a point, was rapid, and after a few movements of artificial respiration breathing was re-established. The pulse, however, remained weak, and for about six hours his condition remained serious, after which he recovered. The operation was postponed and performed a week later under gas-oxygen with local anæsthesia.

Rectal Anæsthesia.

My experience of rectal or colonic anæsthesia is limited, but in such cases as the following it is probably the most satisfactory means at our disposal. A boy of 15 was admitted to hospital with a nail in one of the right bronchi. He was anæsthetised several times with chloroform on a Schimmel-

busch mask followed by warm ether by Shipway's apparatus, while the bronchoscope was introduced. The anæsthesia was unsatisfactory, and had to be intermittent in order to allow the surgeon access without anæsthetizing him as well as the patient. As the difficulties in this respect proved so great I decided to use rectal ether; 4 ounces of a 60 per cent. solution in olive oil were injected, and in 15 minutes the patient was sufficiently anæsthetized to allow of the bronchoscope being passed. With the aid of a little ether occasionally by means of Shipway's apparatus a satisfactory anæsthesia was easily maintained, allowing the surgeon complete freedom of action.

I have quoted the above cases in the attempt to show that there are times when special methods of administering anæsthetics are distinctly advantageous. The drop method has its place, but by no means always does it rise to the requirements of modern surgery.

" The anæsthetist is a man apart. He has to undertake the same trust as the surgeon; the patient's life is in his hands. The ease and perfection of an operation largely depend upon his skill in giving the anæsthetic. He acts without speaking, and his demonstration of his art is mute. The patient, whose pain he prevents, has only time to say ' Good morning,' before becoming unconscious of the benefit he receives, and ere consciousness has completely returned the benefactor has departed. The anæsthetist appears as a prologue to the operation, and then becomes an influence pervading the whole action, having an important but silent part in it, and at the end vanishing strangely."—Moore, Norman: " History of St. Bartholomew's Hospital," vol. 2, p. 750, 1918 edition. C. Arthur Pearson, Ltd.

The following officers have been elected for the ensuing year by the Canadian Association of Anæsthetists: President, Dr. Walter I. Muir, Halifax; Vice-President, Dr. John J. J. Buettner, Syracuse, N.Y.; and Secretary Treasurer, Dr. Harry J. Shields, Toronto.

ON THE TEACHING OF ANÆSTHESIA TO MEDICAL STUDENTS.

By Wesley Bourne, M.D., C.M.,
Lecturer in Pharmacology, McGill University.

TO advance anæsthesia in medicine we believe that those interested in the subject must do more research work and better teaching. The quality of the latter is affected by the former. Realising these, we have, during the past three years, made some improvement at McGill University.

In research the anæsthetists work individually, but in teaching collectively for the purpose of establishing unanimity of doctrine. The student is given his first instruction in anæsthesia in the fourth year during the course in pharmacology. Here, after the theory of anæsthesia has been discussed and the behaviour of certain narcotics has been studied in the laboratory, Professor Barbour allows the anæsthetists to conduct the activities of one week in which there are two lectures of one hour each, one laboratory period of two hours, one demonstration, and, lastly, one conference of one hour. The two lectures are didactic, and deal with the details of the pharmacological actions of the general anæsthetic agents commonly used.

At the laboratory period the students, in groups of four, do the work themselves under the supervision of demonstrators. Dogs are used, half of which have had no preliminary medication, the other half being under the influence of morphine (10 mg. per kg.). It has been customary to induce anæsthesia with ether given by a cone and continued by a tracheotomy tube, a branch of which was connected to a tambour for tracings. Carotid blood pressure was also recorded on the kymograph. Now that the Department of Pharmacology has moved to the new biological building, the procedure for this present session is planned in which the observations will all be made by bloodless methods and mortality reduced to a minimum. The students will be able to maintain anæsthesia by intra-pharyngeal insufflation, and

will follow the circulatory changes by auscultation, as well as by tracings on the kymograph, using a modified Kolls blood pressure cuff recently devised by Dr. Joseph Kaufmann and the author.

With the aid of a synopsis the students are allowed to study the pulse and respiration of normal or morphinized dogs, to induce anæsthesia with ether, using a wooden cabinet which has one side of glass and two openings. One admits air under pressure which carries with it anæsthetic vapour, and the other acts as an exit. Here they note the behaviour of the animal, the reflexes, the movements and position of the eye-balls and movements of the larynx, they mark the stages of anæsthesia and locate the strata of the third stage, and observe the time required for complete anæsthesia.

The animal is now removed from the cabinet and tied on a heated table and anæsthesia maintained by pharyngeal insufflation by passing the tube, which was attached to the cabinet, through a wooden mouth gag to the pharynx. A pneumograph is now adjusted for respiration tracings, and the blood pressure cuff placed on a hind leg, so connected that tracings may be recorded. And now detailed observations may be made under the following conditions :—Light ether anæsthesia, insufficient aeration, a change from light ether anæsthesia to chloroform, deep ether anæsthesia, insufficient aeration again, a change from deep ether anæsthesia to chloroform, after which insufficient aeration once more and then deep chlorform anæsthesia. We avoid the usual instructions of chloroform poisoning. However, should respirations cease, methods of resuscitation are done, such as stretching of the anal sphincter, artificial respiration, cardiac massage, intravenous injection either of epinephrine, 0.1 mg. per kilo mixed with 50 cc. normal saline, or caffeine sodio-benzoate, 50 mgms. per kilo.

The students are called upon to tabulate the observations made under the various conditions enumerated, and to compare as well the differences between the morphinized dogs and those without morphine. Further emphasis is laid upon a comparison of ether with chloroform.

At the demonstration they are shown how anæsthesia may be smoothly induced and conducted in a dog even without

preliminary medication. The animal is placed in a large glass case which has two openings. One permits of connection to an insufflation apparatus, the other acts as an outlet. Air is pumped in to which ether vapour is gradually added. The student becomes impressed with the quietude of this induction, for the animal becomes anæsthetized without struggle and with comparatively little increase in muscular movement in from two to four minutes. It is then quickly removed and placed on a heated table, and with the aid of a Chevalier Jackson laryngoscope intubation is done and anæsthesia maintained by continuous intra-trachael insufflation under low pressure. Blood pressure is observed, as mentioned above. Tracings of respiration are made by a T-tube connection to the intra-tracheal tube. This demonstration affords a further opportunity for explanations of many important details of anæsthesia.

The conference consists in a review of the week's work, when the students are asked and allowed to ask questions.

The practical applications of anæsthesia are taken up in the following fifth year during the course in Clinical Pharmacology. Two lectures are devoted to anæsthesia and such matters are discussed as the choice of anæsthestic agents and methods, the preparation of the patient, the details of conduction of the anæsthetic period and after care. Lantern slides are used to illustrate Guedel's sign chart, some typical anæsthesia charts and several of the more important anæsthetic implements and machines. One gas-oxygen machine is demonstrated in detail.

Practical work is exacted of the students during the final year. Each student must administer anæsthesia himself at least four times, and make in each case a full report to his instructors on what is known as the McGill anæsthetic record here illustrated. Again, in each large hospital an anæsthetic clinic is given once during the session when several short operations are performed and as nearly as possible all of the various anæsthetic agents and methods demonstrated, the surgeons allowing the anæsthetists to hold the floor. The students are encouraged to participate further in the giving of anæsthetics as opportunity offers, and many graduate with fifty or more anæsthesias to their credit.

GILL ANÆSTHETIC RECORD ..... Hospital

NAME M. AGE 32 SEX

SURGEON Dr. DATE 23-8-22 WARD

ATION Hysterectomy + Appendectomy

IAL CONDITIONS PRESENT Fibroid

STHETIC N_2O + O.
HOD closed.
RATUS
MORPH. 1/6 ATROP. 1/150 SCOP. 0.
N AT 8 O'CLOCK am.
ATION ANÆS 1 hr. + 10 mins.
ATION OPERATION same.
TION Trendelenburg's
None.
SION O INTRAVENOUS none
SUBCUTANEOUS none.

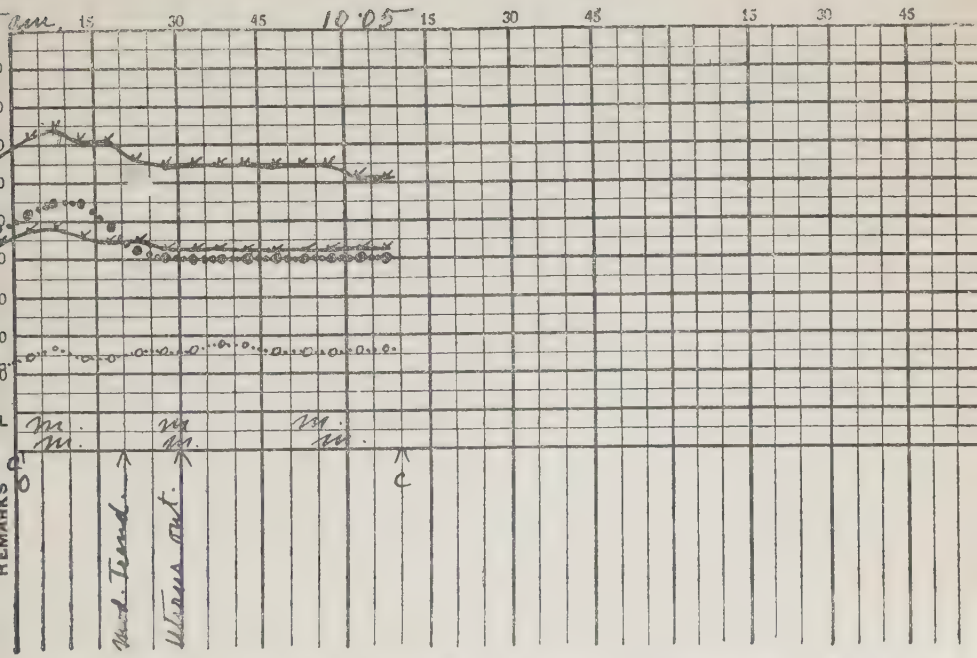
INDUCTION SMOOTH, DIFFICULT, STRUGGLING
HOLDING BREATH, SPASMODIC OBSTRUCTION
CYANOSIS, COUGH, TREMOR

CONDITION AT CLOSE Good

RECOVERY IMMED. EARLY, DELAYED,
AFTER EFFECTS
NAUSEA, VOMITING, NONE, SLIGHT, MOD. SEVERE,
COUGH, once immediately

EMARKS

Anæsthetist.



For the routine administration of ether we use in all of our hospitals the McGill modification of the Ferguson mask, and for which Dr. W. B. Howell deserves most of the credit. For reference text-books we recommend Solmann's "Pharmacology," Cushney's "Pharmacology," and works on anæsthetics by Buxton, Gwathmey, Flagg, Hewitt and Silk. In this connection, in the near future, we hope to have prepared a small book on anæsthesia to be used as a practical guide by students and to be known as the McGill Handbook of Anæsthesia.

To us it is particularly encouraging to note the increasing interest shown by the majority of students, some of whom are now asking to be admitted as house anæsthetists at graduation. This should offer a real solution to the difficulty in obtaining qualified graduates in medicine to administer anæsthetics.

A Diploma in Anæsthesia.

With the steady advance of our speciality the time is rapidly approaching when its status, after the completion of a satisfactory course of higher instruction, would warrant the granting of a Diploma in Anæsthesia.

For those who desire to prepare themselves properly to undertake the uncommon and intricate procedures necessary in what may well be called the higher grades of the practice of anæsthesia, a special course of instruction of from three to six months in a well equipped hospital and university would be more than worth the time and expense, especially if the reward of close application proved the attainment of a diploma.

The first three months could be spent at certain specified hospitals where special demonstrations might be arranged, but the final three months should probably be confined to one such centre as the University of Cambridge.

Candidates for the diploma would, of course, hold a medical qualification, and be required to do a certain amount of practical anæsthetic work.

THE VALUE OF THE REFLEX BASIS IN THE INTERPRETATION OF PHENOMENA DURING GENERAL ANÆSTHESIA.

By S. R. Wilson, M.B., M.Sc., F.R.C.S.E.

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OF late years there has been a tendency to look upon disturbances of bodily function from the reflex basis, for the healthy workings of most parts of the body are dependent upon the integrity of their particular reflex mechanisms, and the latter have also been elaborated through the ages with the additional object of providing these same organs with a protective apparatus. This principle applies to a still greater degree to subjects in a state of general anæsthesia for such activities as still remain are essentially reflex, and whilst it is true that these reflex functions may be thrown out of action by deeper anæsthesia we have further to consider whether in some cases harm may not result.

In any case the reflex basis offers a sound and complete explanation of many phenomena observable during the course of surgical operations conducted under general anæsthesia, and it will be my endeavour to demonstrate this by considering in detail well-known phenomena occurring during operative manipulations which I have now studied for many years, and attempted to explain on a physiological basis.

It has been my habit for some time, whilst instructing students in general anæsthesia, to emphasize to them the importance of reviewing the patient's condition just before the operation commences and to satisfy themselves that their patients are in a safe condition. One first draws attention to the fact that there are three fundamental systems as regards life, viz.:—

The Respiratory System,
The Circulatory System,
The Nervous System,

and accordingly there are three fundamental modes of death corresponding to failure of these same functions. It is true

that other organs such as the thyroid and pancreas are necessary for life, but it is these three systems the *continued action of which is necessary for life* during general anæsthesia. One is fully aware that transient stoppages of these systems may be satisfactorily surmounted but one should beware of such stoppages especially if prolonged, for though life may be restarted, subsequent ill-effects may supervene. For instance a heart which has stopped beating may be resuscitated by cardiac massage, but if more than a few minutes delay be allowed a fatal result is prone to occur later from cerebral convulsions due no doubt to permanent changes in the central nervous system, the sequel of too prolonged cerebral anæmia.

Let us consider then these three systems in turn. First of all is the breathing efficient? The usual answer one receives is "Yes," because they can observe the respiratory movements. Now such movements simply prove that the respiratory centre is still acting and are no proof of respiratory efficiency; in fact as a rule the more vigorous the movements the greater the inefficiency, for the respiratory centre will show exaggerated movement even in advanced asphyxia. The lungs are simply organs of respiratory exchange and respiration as a vital process occurs in every living cell in the body. The true test of respiratory efficiency is seen in the colour of the ear. If the ear is pink oxygen is getting to the tissues in sufficient amount. Should the patient be very anæmic the ear may be very pale but by rubbing it gently a few times between the fingers and thumb a pink colour is readily produced and will serve as an index for the test. Should the head and neck be covered up the condition of the blood in the wound will furnish one with the necessary evidence.

Having satisfied ourselves that the breathing is efficient we have then to investigate whether the circulation is satisfactory. One can best do this by assuming what would happen if the circulation failed. If the heart fails suddenly there will be pallor. If it fails gradually cyanosis. But here a possible fallacy should be noted. If the patient's head is lower than the rest of the body, as in the Trendelenberg and lithotomy positions and even in the horizontal position, blood may remain in the ear by gravity and give a fallacious appearance of a circulation when none exists. To correct this we apply a

further test, known as the skin reflex or colour reflex. Press on the ear with the fingers until a white patch is produced. On removing the pressure the pink colour will immediately return if the circulation is active. If the white patch persists the circulation is stagnant. Though called a reflex this test is not a reflex at all but a mechanical test of the pressure in the capillaries and fine arterioles. In other words it is a "reflux."

The remaining system to consider is the nervous system. How are we to tell whether this system is in a healthy and satisfactory condition? "By means of reflexes." Suppose one is walking along a country road and a frog lies motionless in our path. Is it alive or is it dead? Touch it and it jumps. "Where there's a reflex there is life." Whilst the absence of many reflexes may not necessarily indicate danger yet their presence is of great value, for as long as there is a reflex one can expect to readily resuscitate the patient. If then one enquires what reflex, the answer is "any reflex." It is true that most attention has been paid to the ocular reflexes, partly because they are usually readily accessible to the anæsthetist, partly because the reflex nuclei concerned are situated between the cerebrum and the medulla, and one desires to depress the former whilst preserving the activity of the latter. It may be pointed out, however, that the latter conception is not quite true. Administrators are familiar with the change in the type of breathing when the patient passes into the stage of surgical anæsthesia, and this is to be explained by the fact that the reflex control of the respiratory centre is depressed and its activity is largely maintained by chemical stimulation from the blood. One should beware of too frequent testing of the ocular reflexes especially in early stages as they are readily exhausted and after-irritation of the eyes may supervene. Reflexes elicited by surgical manipulations, reflex contractions of muscles, grunting and phonation will generally supply the necessary information.

Having verified that the fundamental systems are in a satisfactory condition and that the patient has reached a stage of ordinary surgical anæsthesia, a condition of safety and tranquility appears to have been reached, but the supervention of certain surgical manipulations makes us realise that this

is far from being the case and the explanation of these disturbances is to be sought on reflex grounds. For illustrative purposes it is proposed to consider and explain a few well-known manifestations, but a similar application will easily explain other allied phenomena. The special cases about to be considered are :—

(1) The Expulsive Reflex.
(2) The Rectal Cry.
(3) Ocular Complications.

1. *The Expulsive Reflex.*

The upper abdominal or epigastric reflex is familiar to all students of medicine and consists of lightly stimulating the skin over the upper abdominal wall and producing a reflex contraction of the underlying muscular segments. Reflex rigidity of these segments also occurs in disease involving the lining membranes of the corresponding visceral segments and was designated by Mackenzie as the "viscero-motor reflex." There are additional points in connection with reflex action which become of importance in surgical work. In the first place the reflexes become of a nociceptive character, that is to say they assume an intense form with a view to protecting the body from injurious stimuli. Secondly with the removal of higher centres, reflexes tend to diverge from their localised form and overflow into channels not normally associated with the reflex and assume the characters of a mass reflex, *i.e.*, the contraction is no longer limited to the particular segments stimulated but tends to spread to and involve all the neighbouring musculature giving rise to general abdominal and even thoracic rigidity. In an operation on the upper abdomen under general anæsthesia the conditions are ideal for the production of the epigastric reflex, as a mass reaction and its nociceptive character becomes intensified by rough surgical manipulations. Now this reflex was designed by nature as a protection for the upper abdomen and its contents from external injury, and in making this provision modification of the part from surgical interference was entirely ignored. In consequence a reflex which normally produces a tense contraction of the abdominal wall with the protection of subjacent viscera, tends on account of the presence of a gap

in the parietal peritoneum to lead to extrusion of the abdominal contents so that under these modified conditions the upper abdominal reflex becomes an expulsive reflex and as such is a source of worry and trouble to both surgeon and anæsthetist. Appreciation of these facts should help us to eliminate or, at any rate, to alleviate its undesirable effect on the surgeon's work. Full muscular relaxation should be obtained before the operation is commenced, the anæsthesia should be kept absolutely uniform and to a depth at which the corneal reflex is just abolished and the surgical manipulation should be gently performed. It is generally believed that the visceral peritoneum is insensitive, but the handling of an organ and its visceral peritoneal coat results in inevitable traction through its peritoneal connections on the parietal peritoneum which readily elicits the reflex. Anoci-association by the interruption of the lower reflex arc which it produces readily solves the difficulty, as also will infiltration of the recti muscles with novocaine. We are, however, more immediately concerned with the explanation of the manifestation than its treatment and accordingly the second example will now be considered.

2. *The Rectal Cry.*

All students of anæsthesia, even from its early days, have noted the characteristic inspiratory crowing sound which occurs at the commencement of rectal operations when the sphincter of the rectum is dilated. To this sound the name of the " rectal cry " has been given and attempts were made to determine some anatomical association between the rectum and the larynx. The sphincter ani is supplied by a branch of the internal pudic nerve which comes from the 2nd, 3rd and 4th sacral nerves, whilst the larynx is supplied by the vagus, The only anatomical connection is the spinal cord, which at once suggests the possibility of a reflex explanation. Now each viscus is anatomically and physiologically designed for the performance of certain definite functions which are largely controlled on reflex lines. The rectum is essentially designed for the purpose of defæcation and a complicated reflex has been elaborated to this end. Under ordinary conditions the act of defæcation broadly comprises the following sequence of

events. There is first of all a deep inspiration, followed by a closure of the glottis. This leads to fixation of the diaphragm and is followed by contraction of the abdominal muscles, with the consequence that some of the contents of the large intestine are forced into the rectum. The presence of a foreign body in the rectum causes peristalsis of the large intestine, contraction of the coats of the rectum, dilation of the sphincter and extrusion of the rectal contents. All these manifestations occur as one single highly elaborated reflex.

Let us consider what happens when the rectal cry is produced. The surgeon dilates the *rectal sphincter*, in other words he artificially performs the last phase of this complicated reflex. The centres are stimulated and the reflex is called into action but in a reverse order. In consequence we get closure of the glottis followed by a long drawn inspiration with a result that a long drawn crowing inspiratory sound is produced. The rectal cry is to be explained then as a *reversible reflex* artificially produced by a certain surgical manipulation.

3. *Ocular Complications.*

Infection of the eyes, conjunctivitis and even corneal ulceration are possible complications which may supervene after the administration of a general anæsthetic and are usually explained as due to introduction of anæsthetic liquid or vapour into the eye, to lack of cleanliness of the fingers and to too excessive zeal in the testing of the ocular reflexes. Whilst these explanations no doubt suffice in a large number of cases, the writer observed certain administrators produced redness of the eyes and conjunctivitis in their patients with undue frequency. He carefully observed them at work and excluded all the above-mentioned causes only to find vivid red injection of the conjunctiva at the end of the administration. What was the explanation?

Consider the outstanding features of inflammation. We are all aware that irritation of the web of a frog's foot with mechanical, chemical, or other stimuli produces inflammation, also that in the case of the mesentery mere exposure to air will suffice. That is to say in the case of a delicate membrane mere exposure to air is sufficient to set up an

inflammatory change. Now the conjunctiva is a delicate membrane and mere exposure to air would produce such a change were it not provided with a defensive mechanism. There is evidence of this in the ocular changes which may occur after removal of the Gasserian ganglion, and surgeons are in the habit of washing out the eyes with antiseptics and stitching the lids together before performing this particular operation.

Why has this operation such a deleterious effect upon the eye if the ganglion be completely removed?

Because it destroys the reflex arc, and upon the integrity of this reflex arc the defensive mechanism depends. If one looks around during an operation and observes the eyes of those present one will notice that two or three times per minute the eyelids blink. This blinking reflex supplies the eye with a defensive mechanism, it removes fine irritant particles and swills the lachrymal secretion over the front of the eyeball.

If the administration of a general anæsthetic be prolonged, the corneal reflex and lachrymal secretion abolished, then if the lids remain partly open, redness and irritation of the conjunctiva will supervene for the protective blinking reflex and its accompanying secretion is eliminated. At this point it is advisable to draw attention to the varying states of the eyelids during general anæsthesia.

If the anæsthesia is slight the eyelids are tightly closed, if ordinary muscular relaxation is present the eyelids are slightly open, $\frac{1}{8}$–$\frac{1}{4}$ inch, if there is profound relaxation, shock, or the subjects be old people, the lids are widely open. As regards prevention. In addition to avoiding introduction of anæsthetic into the eye and too frequent testing of the reflex, one may introduce a drop of castor oil if the cornea is dull and secretion deficient, but this is not usually necessary. One should from time to time roll the upper lids over the globes of the eyes and approximate the lids and the trouble will be readily surmounted.

Many other instances in which a study of reflex action is of great assistance have also occurred to the writer. For example, in ordinary surgical anæsthesia the knee-jerk is lost showing that the anæsthetic acts upon the lower reflex arc and yet the efferent side of the arc cannot be paralysed, for

one observes the muscles twitch if the motor nerve be stimulated during the operation, so that the anæsthetic must be acting on the afferent side of the reflex arc. A simple observation but one which should make us to doubt whether such graphic statements that "surgical shock is due to bombardment of the cerebral cortex" can possibly be true, particularly when it is stated that nitrous oxide and oxygen are more efficient in the prevention of shock than ether, and yet the former reagent does not depress reflex activity to anything like the same degree as ether, and the cortex of the brain has been shown to be more excitable under nitrous oxide and oxygen anæsthesia than with other general anæsthetics (Jackson).

It is hoped that this article will direct attention to the value of applied physiology in general anæsthesia and lead to the accumulation of more and more scientific data in this progressive art.

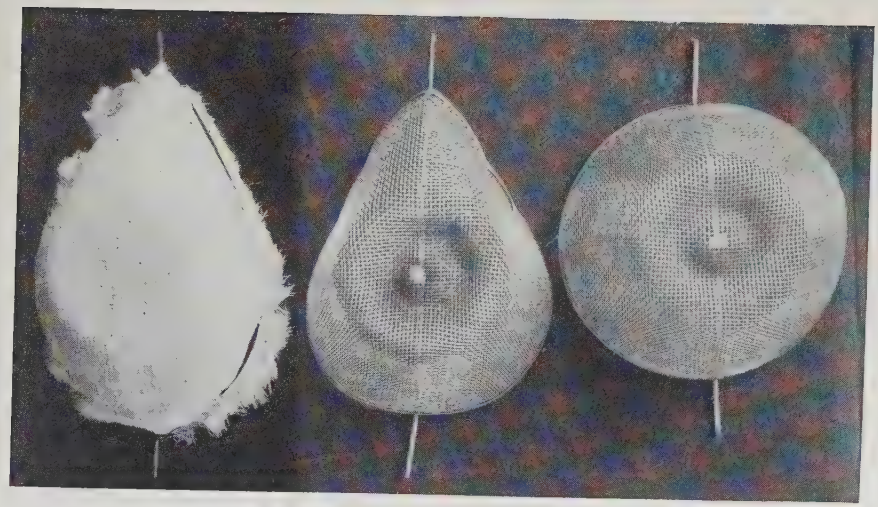
AN IMPROVED OPEN ETHER MASK.

The illustration opposite indicates a simple way in which an open ether mask may be improvised.

The right-hand figure in the print is a gauze cone taken from the interior of a lady's hat box. The middle illustration represents the same after being moulded to a convenient shape in the hands, whilst the left-hand figure represents the mask covered with gauze, retained in position by means of a rubber band passed over the projections at each end.

The mask is rather larger than those in common use and has a cubical capacity of 500 cc., which corresponds to the tidal air of an average patient, and is sufficiently deep to avoid all contact with the nose, which many ordinary masks fail to do, whilst the depression at the top of the cone provides a convenient surface for dropping and localizing the ether, instead of the latter rapidly gravitating towards the face-pad. The mask was devised by Sister Hallett of the Elmfield Nursing Home, Manchester, and myself when short of apparatus for commencing the early inhalations for "stealing the thyroid" in a case of exophthalmic goitre.

S. R. Wilson,
Manchester.



THE NATIONAL ANÆSTHESIA RESEARCH SOCIETY OF AMERICA.

By E. I. McKesson, M.D., President.
Toledo, Ohio.

Quoting from the constitution of the National Anæsthesia Research Society :—

1. The objects for which this Society is formed comprise the collection, promotion and distribution of all forms of information concerning the manufacture, production, use, distribution and handling of any material or substance commonly considered to have anæsthetic properties.

2. The Society shall have as its further object to improve and advance the science and practice and teaching of anæsthesia by such means and to such extent as its resources may permit and its governing powers may direct.

At the time of its organization there was insufficient means for the distribution of current literature on anæsthesia and analgesia. There was a lack of co-ordination of the forces among colleges, researchers and practitioners of anæsthesia, so progress could not be economically maintained. There was a lack of funds also with which to distribute information, and, in order to meet these conditions, the National Anæsthesia Research Society included in its membership many individuals who "declared to the public that they were manufacturers of an anæsthetic or analgesia apparatus." From this latter section of the membership was derived thousands of dollars in the past years,—far beyond the ability of anæsthetists to contribute for the distribution of this information. The Bulletin of Anæsthesia and Analgesia represents one of these activities. The Monograph on Nitrous Oxide and Oxygen in Obstetrics another; still another is represented by the Congress of Anæsthesia which is to be held annually in some city where practical demonstrations can be carried out. Perhaps one of the most important activities, for its possibility of progress in the future, is a Research Week held in some

well-known, highly-equipped laboratory, in which problems of anæsthesia are brought to the attention of physiologists, chemists, pharmacologists, physicists, anæsthetists, all working together while getting the others' view-point. In 1922 this Research Week was under the management of Professor Jackson, of the University of Cincinnati. The work was done largely upon dogs, using various anæsthetics, and trying several new experiments with the co-operation of Professor Fisher, physiologist, Professor Mathews, biologic chemist, and other Professors of the institution. No formal report of these investigations have been published, but the results are appearing in the papers presented by various members of the class in their respective departments. It is hoped that the Research Week may bring together the investigator, the medical teacher and the practical anæsthetist, resulting no doubt in great improvements in the future.

The membership comprises almost everyone interested in anæsthesia in the United States and Canada, and many in other countries. Many of these devote the major portion of their activities to the speciality of anæsthesia. It is easily the largest membership in the United States, and represents no regional field.

Its board of governors consists of professional anæsthetists and business men interested in anæsthesia, its Secretary-Editor being F. H. McMechan, A.M., M.D., Avon Lake, Ohio.

ABSTRACTS OF CURRENT ANÆSTHETIC LITERATURE.

BRITISH MEDICAL ASSOCIATION,
Portsmouth, July, 1923.

Section of Anæsthetics.

(Abstracted from advanced proofs by courtesy of *British Med. Journ.*)

Discussion on *Anæsthesia for Children.* Abstract of opening paper by Harold Sington, M.D., M.R.C.S., L.R.C.P., Senior Anæsthetist, Hospital for Children, Great Ormond Street.

Dr. Sington discussed the subject under four headings :—

1. The preparation of the patient.
2. The choice of the anæsthetic.
3. A few points on administration.
4. The recovery period.

As regards preparation he emphasizes the importance of not starving the patient, and of avoiding purgatives. The toxic action of a general anæsthetic should always be borne in mind and a careful urinary examination made with a view to determining the presence of carboluria and acetonuria. He draws attention to the importance of Frew's work on the influence of diet on acetonuria, and summarizes the preventative measures which are advisable when acetonuria is present.

(1) The operation must be postponed until the acetonuria has been rectified by treatment.

(2) All cases, prior to being anæsthetised should have glucose as a routine for at least two days before operation. Glucose should also be administered during after-treatment.

(3) The patient must not be starved before operation.

(4) Aperients and purgatives must not be given before operation.

He recommends the preliminary injection of atropine half an hour before the anæsthetic but strongly condemns morphine.

As regards the choice of an anæsthetic he recommends as a routine open ether preceded by an injection of atropine. Chloroform should only be employed when the cautery is used. For congenital pyloric stenosis and intussusception gas and oxygen are advised, and statistics of the relative mortality of these conditions under different anæsthetics are given. Ethyl chloride is recommended for dental extractions in children.

Under the heading of administration of the anæsthetic, the importance of gentleness and tact in the management of the child is pointed out, and a warning uttered as regards the administration of the anæsthetic in bed, a proceeding which should be strenuously avoided.

Suggestions given as regards the recovery period are as follows :—

(1) A drop of castor oil in each eye, but not until the administration is over, otherwise the ether dissolves in the oil and irritates the conjunctiva.

(2) Sponge out the mouth with normal saline immediately the administration has ceased.

(3) A rectal sedative should be given as soon as the child is put back to bed. For a child of ten a suitable enema is :

Pot. Brom.	10 grns.
Aspirin	20 grns.
Normal saline	½ pint.

Fatalities from Anæsthetics. By A. L. Fleming, M.B., Ch.B., Senior Anæsthetist, Bristol Royal Infirmary.

Dr. Flemming decided to treat the subject from a clinical point of view, seeing that statistics of death under anæsthetics were generally so lacking in essential details as to be of little use in application to practice.

The total number of fatalities has remained practically stationary in spite of an enormous increase in the number and severity of surgical operations.

He classified anæsthetic deaths into three groups according as to whether they occurred before, during, or after the operation.

The first group was due to the anæsthetic alone and most cases occurred from the use of chloroform in induction, which involves special risks especially if there is struggling or if the position of the patient is altered, for moving the patient may cause a fatal syncope.

Induction with chloroform must be looked upon as too dangerous for routine work. Ether may be administered slowly, or open ethyl chloride or nitrous oxide may be used to facilitate the induction.

The second group—those occurring during operation—is difficult to analyze owing to the numerous factors involved, but more intimate co-operation between surgeon and anæsthetist has helped to reduce their incidence. Whilst on occasion the surgical manipulation may be responsible for the patient's unfavourable condition, it is still the duty of the anæsthetist to notify the surgeon of the danger. A combination of local with general anæsthesia might on occasion avert the disaster. When a patient moribund from disease dies during operation it is misleading to attribute death to anæsthesia.

As regards the third group it is well-nigh impossible to fix the blame. The occurrence of shock or of chest complications is equally dependent upon the operative procedure as the anæsthetic, and these risks can only be lessened by consultation between surgeon and anæsthetist. The tendency to chest complications may be increased by a natural inclination to avoid a tragedy on the table, for the safest anæsthetic during the operation may prove the more dangerous in the long run.

Dr. Flemming drew attention to the difficulties involved in the teaching of anæsthetics, for the student devotes little time to this study, and occasional post-graduate lectures are of little value.

He then reverted to the danger of syncope during chloroform anæsthesia and pointed out that the chief contributory factors are (1) Interference with respiration; (2) the use of too concentrated a vapour.

Interference with respiration might be due to a faulty position of the jaw, or to muscular spasm, but there was a more insidious form of faintness due to accumulation of blood and mucus in the larynx, which was best got rid of by a cough. Deaths under chloroform have also occurred after the patient has been moved from one table to another. The change of posture during deep anæsthesia may cause a fall in blood pressure or in lighter stages to vomiting and faintness. The concentration of the vapour depends largely on the extent to which the air-way is kept free from obstruction.

Operation risks could be greatly lessened by the surgeon and anæsthetist working together to conserve blood-pressure and muscular tone. A fall of blood-pressure due to surgical manipulation will usually be followed by a return to normal if not allowed to persist more than fifteen to twenty minutes.

The question of muscular relaxation is a matter of arrangement between surgeon and anæsthetist but may be facilitated by injecting a local analgesic.

Occasionally deep anæsthesia is associated with a dangerous slowing of the pulse (30—40 beats per minute). In such cases one is justified in refusing to deepen the anæsthesia. Valuable information as regards chest complications might be obtained if a large number of anæsthetists could be induced to send reports of such cases to a special committee.

Anœsthesia by the gas-oxygen-ethanesal and the gas-oxygen-chloroform-ethanesal combinations. By H. Edmund G. Boyle, O.B.E., M.R.C.S., L.R.C.P., Anæsthetist and Lecturer on Anæsthetics to St. Bartholomew's Hospital.

Dr. Boyle opened his paper by pointing out that the aim of all anæsthetists should be to give satisfaction to the operator, and safety and a minimum of discomfort to the patient. For several years he had endeavoured to satisfy these requirements by the above-mentioned combinations. Preliminary medication is absolutely necessary :—

For children, $\frac{1}{200}$ grain atropine.

For older children (14 years upwards), $\frac{1}{6}$ grain morphine.
$\frac{1}{150}$ grain atropine.

For adults, " Hyoscine Compound A." (Burroughs Wellcome).

For strong men, " Hyoscine Compound B." (Burroughs Wellcome).

The injections are given 30 minutes before operation.

As regards the contents of the anæsthetic bottle, he recommends ethanesal alone for children and prefers it to ordinary ether. For young adults and older people equal parts of ethanesal and chloroform. Chloroform alone is only used when the cautery or diathermy is being used in the mouth. The amount of ethanesal or mixture used even in a long case is extremely small (1-2 drachms), so that the toxic action of the anæsthetic is reduced to a minimum. As regards actual administration the bag is filled three parts full of nitrous oxide and oxygen (10-1), and re-breathing starts from the beginning. In a short time the breathing becomes deep, regular and automatic. As soon as this occurs the gases are passed over the surface of the liquid in the anæsthetic bottle. After a few moments the breathing will become snoring and if the operation is on the abdomen, nose or throat the gases should be passed through the mixture so as to pick up a larger dose. The patient is then ready, and after the initial incision gas and oxygen alone are administered. The patient must be kept a pink colour, and if the anæsthesia is too light the other tap must be turned on for a minute or two. Eye signs are not of great value. The only important one is wide dilatation of the pupil. If this occurs remove bag, rapidly empty it, refill with oxygen alone, and apply to the face. After a few breaths resume anæsthesia as before. When anæsthesia has been established, the proportion of nitrous oxide to oxygen is 4 : 1. The air passages must be kept open and an artificial air-way is of great value. The patients rapidly regain consciousness and as a rule are not inconvenienced by nausea and vomiting, and the atmosphere of the theatre does not become impregnated with anæsthetic. Difficulties only occur in abdominal, nose, and throat operations. For some time many anæsthetists have been trying to get a really good relaxant for abdominal work. Gwathmey uses a combination of ethyl-chloride, ether, and chloroform; whilst McKesson recommends a saturation of nitrous oxide. The use of the combination in abdominal work requires intelligent anticipation on the part of the anæsthetist. In his experience abdominal cases were better both during and after operation with this combination than with any other anæsthetic.

As regards nose and throat work, Gwathmey had tried nitrous-oxide and oxygen, but his efforts were interrupted by the war, when he came over to Europe. Dr. Boyle, himself, met with many failures in his early cases, but finally evolved a very satisfactory technique, which is as follows :—

Preliminary medication—as before.

Injections given half an hour before operation.

The anæsthesia is induced as before, and then maintained with a tube in the mouth. An extremely small quantity of the mixture is required and the anæsthesia is chiefly conducted with nitrous-oxide and oxygen. Chloroform alone is used as the adjuvant when dia-

thermy is resorted to. In a large number of cases tubes are passed through the nostrils and the anæsthetic delivered into the endo-pharyngeal space. It is essential to get the patient well under before the operation begins. In nasal operations an artificial air-way is used and that devised by Mr. Clausen (a resident at St. Bartholomew's) is recommended. The results have been most encouraging, and Dr. Boyle hopes to develop the method further.

Endo-tracheal administration of the mixture is a recent development but the technique is not yet fully elaborated. S. R. Wilson.

La Presse Médicale, 23rd June, 1923.

The avoidance of post-operative shock. Misrachi.

The author maintains that the preparation and the post-operation care of patients are as important factors in the production of successful results as is the skill with which the surgeon operates.

Among the many causes of shock a definite place must be given to prolonged anæsthesia; and disaster may often be averted by a combination of manual dexterity with light anæsthesia.

The suggestion is made that before major operations there is need for more careful systematic investigation as to the condition of the cardiac, renal, pulmonary, and hepatic functions; also that the blood, urea and the arterial tension are too often neglected; yet a low blood pressure may in itself be an indication for deferring operation.

As regards dieting it is pointed out that there is a tendency to starve patients too much, and that fasting may not only enfeeble the patient but actually produce acidosis.

It is difficult also to understand why the administration of saline is so often omitted from the preparations for a prolonged and bloody operation.

It is claimed that the use of oxygen inhalation, given slowly and for a prolonged period, may obviate collapse following severe operations with excessive anæsthesia; but the use of oxygen is deprecated in instances where re-breathing and CO_2 conservation are necessary.

La Presse Médicale, 4th July, 1923.

Spinal anæsthesia: inefficacy of, and mishaps with, intra-thecal injection of caffeine. P. Guibal.

Certain accidents, one of which was fatal, already published by M. Guibal in a series of nearly 3,500 cases of spinal anæsthesia have damped this writer's enthusiasm for this method of anæsthesia; his recent group of 420 cases contains three instances of prolonged apnœa, two of cardiac collapse, and one of death. The fatality occurred in a man aged 67 of vigorous habit, the subject of an inguinal hernia which had been strangulated for 24 hours: 10 cgr. of novocain spinally, and 50 cgr. of caffeine subcutaneously were given, and

during operation the patient became stuperous, with pale face and shallow respirations; by the end of the operation his condition had improved, he talked, raised his head, and moved his arms to help with the dressings. There then occurred a bloody evacuation, and signs of collapse, whereupon artificial respiration was practised for 1½ hours, but death supervened. Intrathecal caffeine was not resorted to because the surgeon was afraid to abandon artificial respiration even for the few seconds necessary for the injection to be given.

This objection to the use of caffeine as a curative measure being no argument against its employment as a preventative, M. Guibal adopted it as a routine together with spinal novocain in 15 consecutive cases, but the method was abandoned as inefficacious and dangerous. Its inefficacy was shown by the fact that 15 cases with caffeine produced as many instances (7) of bulbar complications as 700 cases in which novocain was used without caffeine. It seemed dangerous insomuch as quite unexpected troubles cropped up, such as paresis, anæsthesias, bedsores, etc.

Many cases are related in detail to illustrate the difficulties and dangers referred to, and M. Guibal describes the theoretical grounds upon which he bases his objection to caffeine in this connection.

La Presse Médicale, 7th July, 1923.

Two new anæsthetics. L. Cheinisse.

Experimental research has shown that *acetylene* and *ethylene* can each be used for the production of general anæsthesia. Paul Bert showed that plus pressure was necessary in order to render N_2C and C_2 anæsthesia efficient, and Wieland explains this as due to the fact that under ordinary conditions the volume of oxygen negatives the action of nitrous oxide: experiments on animals prove that the processes influenced by N_2C are those which depend on an oxygen supply, and herein lies an essential difference between gas and the anæsthetics " proper," such as chloroform and ether, which paralyse living cells whether aerobic or anaerobic. Considering that its solubility in water was an important factor in the action of nitrous oxide, Wieland was led to try acetylene which is even more soluble, and he found the resulting anæsthesia analogous to that of N_2C, with this difference, that acetylene acted more energetically even in more dilute concentrations, the proportion varying between 3 of acetylene with 2 of oxygen, and 2 of acetylene with 3 of oxygen.

Gauss and Wieland have employed this method in 220 cases, and claim that it is free from any harmful effect upon the circulatory or respiratory systems. The duration of their operations varied from three minutes to two hours and sixteen minutes.

Ethylene was used in experiments on animals by Luckhardt and Carter in America and Canada. They found that its action was more

rapid than that of N_2C, that blood pressure was not affected, and that a good degree of muscular relaxation was obtained. At the Presbyterian Hospital in Chicago 106 patients were operated on under this anæsthetic and everybody concerned was favourably impressed.

La Presse Médicale, 11th July, 1923.

Anœsthesia of the abdominal plexuses by one injection of a solution of scurocaine. Marc Roussiel.

In a man aged 66, the subject of intestinal obstruction with fæcal vomiting and extreme exhaustion, the following method gave good results :—The abdominal wall having been anæsthetised by local and regional methods, the abdomen was opened without pain but immediately the small intestines were extruded very severe colic occurred. An injection of 45 ccm. of $\frac{1}{2}$ per cent. solution of scurocaine was made in the neighbourhood of the superior mesenteric artery at the root of the mesentery; in four or five minutes anæsthesia of the small and large intestines was complete and remained so throughout the operation.

It is claimed that by this method of injection an anæsthesia is obtained which involves the superior and inferior mesenteric, the lumbo-aortic, the renal, and the solar plexuses.

Gazette des Hopitaux, 8th Sept., 1923

Methods of anœsthesia in gynœcology and obstetrics. M. O. Rapin and M. Schickele.

The ideal to be sought for is a method of relieving pain during confinement without inflicting injury upon either the mother or the child; when carefully employed anæsthetics are able to relieve the mother of distress and shock which are factors in making some women dread future confinements, and in this respect anæsthetics may be regarded as a means of preventing one of the many causes of failing population.

Spinal anæsthesia, lasting only one or two hours, necessitates re-injection, a dangerous procedure, and has therefore been given up in normal labour; twilight sleep is risky on account of its tendency to produce cyanosis in the child, or to cause so intense an intoxication in the mother as to unduly prolong the course of labour. The author advocates chloral during the first stage of labour, and ethyl chloride during the second stage; he finds N_2C unsuitable except in the hands of very expert administrators owing to the narrow margin which it provides between asphyxia on the one hand, and consciousness on the other.

In gynæcology general anæsthesia will probably continue in favour, preference being given to ether, or where this is contra-

indicated, to chloroform; kelene being suitable only for short operations; and nitrous oxide failing to provide sufficient muscular relaxation.

Infiltration anæsthesia, alone or in conjunction with kelene narcosis, is safe and suitable especially for plastic operations upon the perineum, and deserves a wider popularity. Spinal anæsthesia has gained much ground but has certain drawbacks, such as persistent headache and meningeal and ocular complications, instances of death are nearly as frequent with this as with other methods, and it sometimes fails from the anæsthetic point of view. A. L. Flemming.

American Journal of Obstetrics and Gynæcology (508 N. Grand Boulevard, St. Louis, U.S.A.), Aug., 1923.

Resuscitation in abdominal surgery. W. Wayne Babcock.

Dr. Babcock, citing drills adopted for emergency use in schools, on shipboard, etc., suggests the same drills to be prepared for emergency use in the operating theatre in case of collapse of the patient. He states that deaths are occasionally caused by the unpreparedness of the staff to proceed promptly and intelligently with proper methods of resuscitation. In his scheme the operator, his assistants, and the nurses all have their specified duties in the work of resuscitation, and if these drills are conducted regularly there is little confusion when the time comes to act seriously.

In the actual emergency treatment is directed towards the re-establishment of the circulation within *seven minutes;* the continuance of the tidal air movements in the lungs; and the maintenance of the patient's temperature. After seven minutes molecular changes in the cerebral cortex make death absolute.

The first procedure after establishing a clear airway is the intravenous injection, into a convenient vein in front of the left elbow, of 200 mils of warm physiologic saline or Ringer's solution, to which 10 minims of a 1 : 1000 solution of adrenalin has been added. With the first evidence of a return of pulsations of the heart, stop the injection by compressing the tube to prevent over-stimulation, since as little as half a minim of adrenalin may be ample and 10 minims might violently strain the heart. If the pulse again fails continue the injection. If the heart does not respond the injection is rapidly continued with successive additions of 15, 20, 30, or more minims of the adrenalin solution. There should be no hesitancy in the emergency to make a free incision through the skin, pick up the vein upon the finger and accurately introduce the needle into the lumen of the vein by sight.

Artificial respiration is next tried—sixteen respirations to the minute—or this failing, a piece of gauze is placed over the patient's mouth, his nostrils are compressed, and the anæsthetist quickly filling his own lungs to the utmost, mouth to mouth insufflation is

produced. By pressure over the upper abdomen the air is prevented from distending the stomach.

Further measures are cardiac massage, and, lastly, three to sixty minims of strong adrenalin solution may be injected by a fine long needle directly into the cavity of the left ventricle. The internal mammary artery lying 12 mm. lateral to the sternum must be avoided.

In Dr. Babcock's clinic he has constantly available a small emergency tray, and the senior operating-room nurse instructs the junior nurses as they report for duty to prepare and have same in readiness. If the knife, needles, and other metal parts are made of non-corrosive material they may be sterilized and re-sterilized without deterioration. A flask of saline solution, kept during operation at body temperature, with the little tray, is all the apparatus required.

Archives of Surgery (335 N. Dearborn Street, Chicago, Ill.), Sept., 1923.

De-etherization by means of carbon dioxide inhalations, with some observations on pulmonary ventilation and ether tension during anæsthesia. James C. White.

This paper is the report of the research undertaken to verify the suggestion made two years ago by Prof. Henderson and H. W. Haggard, that carbon dioxide, administered to ether patients, would do away with certain bad after effects, and which was based upon the physiologic principles (1) that ether, being a volatile substance carried by the blood, will be eliminated chiefly through the lungs; (2) that the rate of its elimination must, therefore, vary directly with the volume of pulmonary ventilation. Since carbon dioxide is a natural stimulus to the respiratory centre they thought its addition in small quantities to the inspired air would accomplish this purpose.

White studied forty cases, as a result of which he came to the following conclusions: By the use of carbon dioxide the volume of respiration can be raised to any desired level; recovery of consciousness is from three to five times more rapid; blood pressure, circulation and colour are materially improved; nausea, vomiting and other subjective disagreeable sensations following ether anæsthesia are reduced.

To make these tests the Henderson carbon dioxide apparatus was used, the cases covering a variety from skin graft to cerebellar tumour. In the first series carbon dioxide was started as soon as the wound was closed, respiration never failing to show an increase within the first minute, and at the end of two or three minutes it could be kept at any volume desired.

In the thirty-five cases in which carbon dioxide was administered uninterruptedly the patients recovered consciousness sufficiently to open their eyes and answer to their names in fourteen minutes; carbon dioxide being discontinued they relapsed again. If it was

continued five or ten minutes beyond this time the patients remained wide awake and were fully conscious on return to the ward. In forty control cases, untreated in this way, the average time taken to recover consciousness was one hour and fifteen minutes.

The American Journal of Surgery (Quarterly Anæsthetic Supplement), July, 1923, 15, E. 26th St., New York City.
The value of ether and controlled re-breathing in ether anæsthesia.

The author states a case for the more extended use of the closed-ether method, with re-breathing, and suggests that putting the *ether under regulated pressure* enhances its anæsthetic value.

In pointing out the good and bad features of the open and closed methods he suggests the possibility of obtaining the good of both by arranging " the working mechanical principles so as to utilize the salient good points of each and eliminate the objectionable features of both." This appliance should flexibly control the re-breathing bag and ether vapour so that accumulated dosage during re-breathing cannot take place.

Working from the hypothesis that of the 20 per cent. of oxygen inhaled from the air only 2 per cent., or one-tenth, can be demonstrated to exist in the tissues and blood stream, but that this percentage can be increased under pressure, he asks, what would be the results if we placed ether vapour under tension? Would it not be a happy situation if by pressure we could force into the blood stream the required amount of gaseous ether by using only one-tenth of the dosage ordinarily required *without* pressure?

He gives a series of 770 cases in which this method was used, the ages of the patients ranging from 20 to 94 years. He utters a word of warning, however, that " pressure and re-breathing " is not free from dangers, but these may be prevented by careful and skilful administration.

Gaceta Medica de Caracas (Caracas, Venezuela), Jan. 15, 1923.
Intraspinal anœsthesia. L. Razetti.

In this article Razetti gives replies received from eleven different American surgeons to a request for comment upon reprints of his Study of Intraspinal Anæsthesia. Meeker of the Mayo Clinic reports one death in 400 cases, while A. J. Ochsner had only one mishap in several years. W. W. Keen and the others think the method somewhat dangerous. Elliott Cutler notifies one death from the drug invading the medulla, and gives it as his opinion that all cases having spinal anæsthesia run this risk. Daniel F. Jones uses it in cases of diabetes, senile gangrene, operations upon the rectum in very debilitated persons, and in the second part of the two-stage operation for rectal cancer. The fall in blood pressure was alarming in a large number of cases.

Beiträge zur klinischen Chirurgie (Tübingen), 1923.

Resuscitation of the heart. HARTTUNG.

Harttung records 76 cases of *massage of the heart* with resuscitation in 35 and permanent recovery in 20. Massage only from below the diaphragm proved effectual, though dangerous, in one case necropsy showing a valve laceration. Brain functioning ceases in ten minutes, after which the procedure is useless. Intracardiac injection is preferable as being less dangerous, his method being to inject 1 cc. of the one per thousand solution of epinephrin into the right ventricle through the fourth interspace, close to the sternum.

Deutsche Zeitschrift für Chirurgie (Leipzig), March 20, 1923.

Blocking the splanchnic nerves. E. METGE.

Metge applied Kappis' technique in 104 cases, having given scopolamin and morphin beforehand. The blood pressure in 78 cases dropped to under one-half without doing any special harm. He reports three deaths from pneumonia in 112 operations under splanchnic nerve blocking, but he had seven pneumonia fatalities under other anæsthetics in the same number of operations which were performed simultaneously.

Sei-I-Kwai Medical Journal, Tokio, June, 1923.

Effect of chloroform narcosis on growth of transplanted animal tumours. KYMURA.

Kymura and two colleagues found, in a series of experiments upon animals under anæsthesia or during operation, chloroform had no marked stimulating effect on the growth of inoculated tumours.

Klinische Wochenschrift, Berlin, May 7, 1923.

Lundwall and Mahnert report a series of twelve cases of *severe and persistent headache after intraspinal anæsthesia.* They injected 40 cc. of a 40 per cent. solution of hexamethylenamin into the ulnar vein with prompt relief.

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JOHN SNOW AND THE ADVENT OF CHLOROFORM.

By Dudley Wilmot Buxton, M.D., B.S., M.R.C.P.,
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ALTHOUGH we owe to Sir James Young Simpson the introduction of chloroform, it was Dr. John Snow who first studied and explained the physiological and pharmacological action of that anæsthetic and placed our knowledge of it on a scientific basis. The work of this man, done more than sixty years ago, although it has been amplified and extended, still stands as a monument and example of accurate research. To appreciate Snow's labours at their just appraisement we must know the difficulties which surrounded his undertaking and the narrowness of physiological knowledge in the days in which the enquiry was attempted and brought to a successful issue.

At the time of which we write France led the world in physiological research, but even Majendie, great as he was, was dominated by Cuvier and Bichat, who belittled experimental work and found the road to salvation only along the straight, narrow path of biology. Further, Majendie was a vitalist, and although an indiscriminate experimenter, he failed to recognize that there is no hard and fast line between vital and physico-chemical processes. Johannis Müller, facile princeps in Germany, was essentially a morphologist, while in England the age of experimental physiology was only in its infancy. However, Majendie has to his credit that he proved the accuracy of Bell's guess anent the function of the anterior and superior spinal nerves. Further, by taking for his assistant Claude Bernard he brought the world to a new epoch

of accuracy in research, an accuracy which at times was lacking in his own work. With the advent of Bernard we come to grips with the theme of this paper—the study of chloroform. However, the picture would be incomplete without reference to Jean Baptiste Andre Dumas (1800—1884), who first prepared chloroform from trichloracetic acid and ammonia; to Soubeirau, who adopted the process involved in the interaction of ethyl alcohol and acetone; and to Liebig, using chloral and alkalies.

Marie Jean Pierre Flourens (1794—1867), who has been called, somewhat unkindly, "the showy Perpetual Secretary of the Academy of Sciences," whose work on the semi-circular canals and on the nervous system of vertebrates brought him into touch with chloroform, although he failed to appreciate its utility, being impressed by its dangers rather than by its beneficent powers as an anæsthetic.

So we return to Bernard, who was perhaps the first seriously to consider the properties of anæsthetics. However, his "Leçous" on the effects of toxic substances in which he dealt with ether, carbon monoxide, curari and on anæsthetics in their relation to asphyxia were probably unknown to Snow, and certainly did not adumbrate the practical application of chloroform as an anæsthetic and adjuvant to surgery. Majendie held the view, to us almost incredible, that pain had its uses in surgery. He wrote: "Pain always has its usefulness"; he doubted any advantage "in suppressing pain, by rendering patients insensible during an operation." He adds: "It is a trivial matter to suffer, and a discovery whose object is to prevent pain is of a slight interest only." The writer's father, who witnessed some of Majendie's experiments, used to express his horror of the scientist's callousness to the suffering which he inflicted.

It will be seen from what has been set forth that, so far as physiology is concerned, when Snow took up the subject of the behaviour of anæsthetics but little actual knowledge was available, and practically no formal endeavour had been made to investigate how these agents could be safely employed in the service of suffering humanity. It is true that John Hill Hickman, a country practitioner living in Ludlow, Shropshire, had attempted, early in the nineteenth century, to use ether to

mitigate pain during operations, but his work had been ignored in England and in France. In 1842 Crawford W. Long certainly used ether in surgical operations, and did so successfully, but unfortunately made no public pronouncement of his discovery at the time of his first successes, so that N. T. G. Morton's public demonstration of the successful use of ether in 1846 at the Massachusetts General Hospital was the event which introduced the discovery to British surgeons, and incidentally to John Snow.

In Bernard's writings we find reference made again and again to the difficulties he had to surmount owing to the absence of properly equipped physiological laboratories and a scientific armamentarium. If this was the case in France, which, as has been said, was at this time leading the world in physiological research, it is a tribute to Snow, who, working in England alone and with scant means at his disposal, was able to initiate and complete a unique research. The actual standard of knowledge was low, in spite of the work of Flourens on the nervous system, and Bernard's research on the chorda tympani leading him to believe that vaso-constriction and vaso-dilatation played no unimportant part in the mechanism of the circulation, a conclusion which Brown-Séquard had arrived at at an even earlier date; in spite also of the brothers Ernest and Eduard Weber, who in 1846 had demonstrated that stimulation of the peripheral ends of the severed vagi brought about cardiac inhibition.

These accepted discoveries do not appear to have been associated with any attempt to explain the action of chloroform, and so the clue to the chloroform problem was either ignored or not appreciated. It is true that Bernard formulated his theory, which was that this anæsthetic owed its power to the property it possessed of rendering the brain anæmic, a result as we now recognize as being largely due to vaso-motor action and not simply to the direct influence of chloroform on the nervous tissues of the brain.

Thus we see that Snow had comparative little help from the physiologists of his day. He stands forth as one of the few practical anæsthetists who, adopting the experimental method, learnt the science of anæsthesia underlying the art of inducing a safe management of narcosis.

The life of Snow is more than of passing interest, exemplifying how a keen brain and dogged perseverance can surmount even the greatest obstacles.

Born in 1813, John Snow was the eldest son of a farmer. He spent his early years on his father's farm, receiving a scanty education at a private school in York. At the age of fourteen he was apprenticed to a surgeon, one William Hardcastle, practising in Newcastle-on-Tyne. The Newcastle Infirmary, where he studied, gave him his chance, and he worked with that avidity for the acquisition of knowledge which characterized him throughout life. When seventeen he became a vegetarian and total abstainer, and persevered in a strict regimen for eight years, until his health was seriously affected, obliging him to modify both his views and his practice. The point of interest in his life, and one which demonstrated Snow's capacity for research and clear thinking, was his work at the Killingworth Colliery, where during the terrible outbreak of cholera in 1831-32 he was sent to attend the victims of that dire malady. Although it is somewhat anticipating the events of later years, it may be pointed out that the experience of cholera which he had in Newcastle and Killingworth led him subsequently to publish his contention that cholera was spread through water contamination His views at that time received no adequate recognition, and although his pamphlet which proved the cause of the 1854 outbreak was the pollution of the water supply, was lodged with the judges for the French Institute prize of £1,200 dealing with the prevention of cholera, it was not even mentioned by the judges.

In 1836 Snow came to London and studied at the Hunterian School of Medicine in Great Windmill Street, and at the Westminster Hospital. He took the L.S.A., M.R.C.S., and eventually in 1844 the M.D. (Lond.). He started practice in Frith Street, Soho, without friends and without any influential backing, living the simple life because such patients as came to him were as poor as himself.

Snow never lost heart, and eventually won through. His papers read before the Westminster Medical Society (now the Medical Society of London) at length brought him some recognition, and after various researches, comprising asphyxia

and resuscitation of new-born infants, Snow turned his attention, in 1846, to ether. This agent, after its first trials in London, had fallen somewhat into disfavour. The reason for this is not far to seek. The apparatus employed was crude and wholly unscientific, and an intermittent rather than a continuous system of administration was commonly adopted. Snow at once recognized these defects, and instituted experiments with ether. These enabled him to suggest a more reliable method of etherisation. "When the inhalation of ether," he writes, "was first commenced, the inhalers employed consisted generally of glass vases containing a sponge to afford a surface for the vaporization of ether. Both glass and sponge being very indifferent conductors of caloric, the interiors of the inhalers became much reduced in temperature, the evaporation of ether was very much checked, and the patient breathed air much colder than the freezing point of water containing very little of the vapour of ether." This led to the invention of his ether inhaler, in which metal was used and water employed to prevent freezing. The air was made to pass over a large surface of ether by the use of a spiral volute soldered to the top of the inhaler and reaching nearly to the bottom.

In 1847 Snow published in book form* his researches on ether and an account of this inhaler, and commenced to give demonstrations at St. George's, University College Hospitals and elsewhere. Then came the dramatic introduction of chloroform and the era of Simpson's domination of the whole theatre in which the rival anæsthetics, ether and chloroform, were struggling for supremacy. Snow's work on ether was lost sight of, and his book dealing with it was still-born.

James Young Simpson, the son of a baker, was a man of a compelling personality. In 1847 he was in extensive practice as a surgeon and obstetrician, and had adopted the use of ether in his operations. His essays on this agent and his eloquent appeals to common sense, in which he contested the quasi religious view that the pangs of child-birth are ordained by Providence and so should not be mitigated are too well known to need quotation. However, Simpson found that the smell of ether was unpleasing to

*On the Inhalation of the Vapour of Ether in Surgical Operations.

many patients and was disagreeable to himself as it made his clothes malodorous. He tried various chemical agents. Professor Miller tells us that Simpson, after a hard day's work, would call in his assistants, Matthews Duncan and Keith, and the three would sit at the dining-room table and inhale from cotton wool contained in tumblers. Among the agents tested was chloroform, and its effect was rapidly demonstrated by the three seekers after truth falling out of their chairs and lying unconscious under the table. Curiously enough, no unpleasant after-effects are spoken of; so Simpson adopted chloroform, used it extensively, and introduced it to the world in his paper read before the Medico-Chirurgical Society of Edinburgh, Nov. 1847.

With characteristic energy Snow renounced his research on ether and commenced his historic work on chloroform. It will be convenient to leave for the present the discussion of these experiments and to trace briefly the history of the remaining years of Snow's life.

From 1848 onward Snow divided his attention between experiments undertaken to explain the action of chloroform and other narcotics and the further study of the causation and prevention of cholera. The narcotic series included chloroform, carbon monoxide, carbon dioxide, cyanogen, hydrocyanic acid, "Dutch liquid" or "monochlorurretted chloride of ethyle" (ethidine dichloride), amylene (pental), and puffball, his results being focussed in papers printed in the *Medical Gazette* and delivered before the Westminster Medical Society. He became one of the most respected members of this association of "all the talents," and was in due course inducted into the Presidential chair. Besides demonstrations of the use of chloroform as an anæsthetic given in various hospitals, Snow tried several of the narcotics and their allies, and even ammonia, as inhalations in chest diseases. These were conducted at the Brompton Hospital, and demonstrate his remarkable clinical acumen. He became associated as an anæsthetist with Liston and the other leading surgeons, although it would appear that he never played for self-aggrandisement and was rather forced into this line of practice by the value of his work than by any attempts of his own to exploit his talent.

It is said that Snow's income never rose above one thousand pounds a year, and his simple mode of living underwent no change even when the exiguous days of his poverty had passed. He administered chloroform to Queen Victoria in 1853, when Prince Leopold was born, and again in 1858, at the birth of the Princess Beatrice. The only teaching post which fell to Snow was a brief tenure of the Lectureship of Forensic Medicine in the Aldersgate School of Medicine which he undertook in 1845, although he appears to have assisted in the out-patient department of more than one general hospital. The poor were always with him, and he sought to relieve their sicknesses with loving care.

In 1848 he collected his papers on anæsthetics, and wrote his work entitled "On Chloroform and other Anæsthetics : their action and administration." This was published posthumously under the editorship of his friend and pupil, Benjamin Ward Richardson. As Snow sat correcting his proofs on June 9th, 1858, he wrote the word "exit" and fell unconscious in an apoplectic seizure from which he died on June 17th. Snow had never married. He died a simple-hearted gentleman, a shrewd and accurate observer and one to whom science and truth were as the breath of his nostrils.

LABORATORY AND CLINICAL EXPERIMENTS WITH ETHYLENE AND OTHER HYDROCARBON GASES.*

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There are fourteen hydrocarbon gases, namely :—

Acetylene, C_2H_2.
Ethylene, C_2H_4.
Prophylene, C_3H_6.
Butylene, C_4H_8.
Allylene, C_3H_4.
Crotonylene, C_4H_6.
Terene, C_5H_8.

And the vapours :—

Benzene, C_6H_6
Styrolene, C_6H_8.
Naphthalene, $C_{10}H_8$.
Pentane, C_5H_{12}.
Hexane, C_6H_{14}.
Heptane, C_7H_{16}.
Octane, C_8H_{18}.

While all of them have anæsthetic value, just a little more care has to be exercised in their manufacture in order to make them fit for animal and human experimentation than when used for entirely commercial purposes.

If Easson Brown, who read a paper before the Academy of Medicine, Toronto, February 20, 1923, on "Experiments with Ethylene as a General Anæsthetic," or Luckhardt and Carter of Chicago, who published their first paper in the "Journal of the American Medical Association," March 17, 1923, on "The Physiological Effects of Ethylene," merely stumbled upon this gas in an accidental way and proceeded to develop its anæsthetic and analgesic properties without carefully looking into the properties of the other gases, then it may be possible that some other gas of this series will be found later

* Read before the Southern Association of Anæsthetists, Washington, D.C., November 13, 1923.

that is far superior to ethylene in every way. At the present time we must give to Brown, Luckhardt and Carter full credit for introducing a new anæsthetic and powerful analgesic agent.

When it is remembered that chloroform was known for over sixteen years, nitrous oxide for over seventy-two years, ethyl chloride for over one hundred years, and ether for over three hundred years before being used as anæsthetic agents, we can grasp the possibilities and appreciate in a measure what the introduction of a new anæsthetic agent means.

While at least one of the hydrocarbon gases, acetylene (C_2H_2) may prove of even greater value than ethylene, for the purpose of this paper we propose to confine our remarks to ethylene. Ethylene (C_2H_4) is an unsaturated hydrocarbon, is not a highly reactive gas, and is not likely to form compounds in the body. With the conditions under which it would be used as an anæsthetic, it is non-explosive (Brown). Luckhardt uses orthophosphoric acid and alcohol in its preparation. He states that ethylene apparently does not enter into chemical combination with the hæmoglobin of the blood and that it probably exists in the blood during anæsthesia in a state of physical solution. Both Brown and Luckhardt agree that 80 per cent. ethylene and 20 per cent. oxygen is the proper proportion for anæsthetization. "*Blood pressure* remains good even at the end of an hour's anæsthesia." (Brown).

The laboratory work for this paper was done in the Pharmacological Department of the University and Bellevue Medical College under the supervision of Dr. George Barclay Wallace, using white mice and dogs. To determine the comparative value of ethylene we used ether and nitrous oxide as a control. The experiments throughout were conducted from a comparative and practical standpoint and not to decide any detailed physiological or pathological questions. The smaller animals were placed in a glass vessel, in the stopper of which was a short tube leading from the anæsthetic. A glass overflow tube passed through the same stopper and extended to within half an inch of the bottom of the jar. In killing a number of animals first with ethylene and then nitrous oxide without oxygen, there was always sufficient warning with either gas to resuscitate the animal if necessary.

If the animal was taken out before the auxiliary respiratory muscles were brought into play (as indicated by interrupted and gasping respiration) they could easily and always be revived. If a small amount of oxygen was used, the period in which resuscitation could be counted upon was considerably lengthened. Ethylene seemed to affect the brain to a greater degree than nitrous oxide, as indicated by the bulging eyes with death from ethylene. If respiration ceased entirely before the attempt at resuscitation, the result was always in doubt and rarely successful. When oxygen was used the induction was smoother, the maintenance easier, and the relaxation better with ethylene than with nitrous oxide. If a small amount of ether is used with either gas, induction, maintenance, and relaxation are all improved. We did not saturate or double saturate the animals and then continue the anæsthetic, as we consider this an unphysiological process.

With ether and air (or oxygen), induction is slower but maintenance is easier and relaxation is better than with either ethylene or nitrous oxide. With ethylene and oxygen, there seemed to be a tendency to accumulation, or a tendency to sink deeper when the gauges were set at a given place. However, a satisfactory anæsthesia could always be maintained by a slight increase in oxygen after the first few minutes.

Comparatively, nitrous oxide seemed more of an asphyxiant, and the margin of safety narrower, than with ethylene. In order to maintain a smooth anæsthesia a certain amount of cyanosis seemed indispensable with nitrous oxide; with ethylene, the same degree of anæsthesia could be easily maintained with the animal's paws and nose pink at all times. The comparative analgesia was not attempted at this time, but was later determined in the human subject very definitely.

A sufficient number of dogs were used to determine that:

1. With all of the anæsthetics anæsthesia was safer and easier with morphin than without the preliminary, and

2. That an even plane of anæsthesia was easier to maintain with ethylene and oxygen than with nitrous oxide and oxygen.

Before proceeding with the clinical administration the animal experiments were repeated in the offices of M. Ecker, dentist and oral surgeon, in order to convince him that his

patients would be quite as safe under ethylene and oxygen as under nitrous oxide and oxygen. In association with Ecker, over one hundred administrations with ethylene and oxygen were given, and while this is a comparatively small number, they were sufficient to confirm the results of the animal work; and by way of comparison with over 50,000 administrations of nitrous oxide and oxygen, and 20,000 administrations with the same gases passed over a mixture of urethan and paraldehyde in Ecker's previous work, we were able to reach very definite conclusions. The administrations were given with ethylene and oxygen alone, and also with nitrous oxide in sequence and combination. When nitrous oxide and oxygen were used for induction and ethylene added, the induction was smoother but the analgesia was not so great. When the ethylene and oxygen were passed over paraldehyde or essence of orange, the odour seemed less objectionable than when used alone. In only two cases out of the hundred was there nausea and vomiting. The administrations averaged from 40 seconds to three minutes, the longest in this series being seventeen minutes. Each patient was questioned as to nausea, headache, or unpleasant odour, and with only three exceptions the replies were negative. Recovery seemed just a little slower than with nitrous oxide and oxygen, but all were able to walk unassisted from the chair to the adjoining room.

The most important result of this series of cases was the determination of the amount of analgesia. The best results were obtained with an induction of two parts of ethylene and two of oxygen, changing in forty seconds to four parts of ethylene. With this proportion the patient was always pink, and when the operation began there was no movement whatever. If the face mask was used analgesia was present almost twice as long as when nitrous oxide and oxygen was used.

It is a well-known fact that of the four anæsthetics—ether, chloroform, ethyl chloride, and nitrous oxide—ethyl chloride possesses by far greater analgesic properties than the others; yet ethylene possesses as great, or even greater, analgesic properties than ethyl chloride. For instance, with ethylene an extraction can be made either before consciousness is entirely lost or after the return of consciousness without the manifestation of any pain reflexes. Using the nasal inhaler, the analgesia may be continued indefinitely with an active lid

reflex and pink colour. With nitrous oxide the patient may be snoring and slightly cyanosed, yet almost invariably there would be a slight reflex or movement, although the patient would have no remembrance of pain afterward. In this series not a single patient had to be strapped or restrained in any way. In every instance the brain block was more complete than the control case when given nitrous oxide and oxygen, the analgesia appearing earlier and lasting much longer. The finger could be swept around the pharynx without eliciting any reflex whatever, thus suggesting this agent as the ideal one for adenoids and tonsils.

In my clinical work I have not used this gas with oxygen alone, nor do I intend to do so except for short or unusual cases. My own practice is to use a very large mask, about four times the size of the ordinary chloroform mask. Starting the anæsthetic with two parts of oxygen and four of nitrous oxide, I pass this over the surface of anesthol for about two minutes, or until the patient is semi-conscious; then I begin adding ether. A change is then made to ethylene, the anesthol and nitrous oxide being turned off and used no more during the operation. The anæsthesia is continued with two parts of oxygen and two parts of ethylene passed through the ether. Surgical anæsthesia is present in five minutes. A type of anæsthesia ensues that is characterized by extreme relaxation, good colour, pulse, and respiration. Advantage is thus taken of the full analgesic qualities of both ethylene and ether without pushing the patient near the danger zone. I employ this method in gall bladder cases, using ethylene throughout, neither surgeons nor nurses being aware of the fact unless told. The ether completely masks the odour of ethylene. In other short cases the analgesic properties of ethylene have been fully demonstrated. About one-third less ethylene and one-half more oxygen were used in this series than with the usual technique of nitrous oxide and oxygen.

In ethylene we have a most valuable agent and one that is destined to remain with us, provided we can obtain a pure gas and that no attempt is made to use it in an extreme way, that is, using double saturation or discarding ether entirely; remembering always that preliminary medication and a combination or sequence of anæsthetics are, generally speaking, far safer than any single agent.

THE ENDO-TRACHEAL ADMINISTRATION OF NITROUS OXIDE-OXYGEN-ETHANESAL AS THE ROUTINE ANÆSTHETIC OF CHOICE FOR MAJOR SURGERY.

By C. Langton Hewer, M.B., B.S. (Lond.).

THE administration of anæsthetics by the endo-tracheal route has been developed comparatively recently, but the results are so uniformly excellent that it is difficult to see why this method should not be employed as a routine for all cases where the necessary apparatus is available.

Advantages of endo-tracheal anæsthesia.

(1) It is probably the safest known method of anæsthesia, whether general, local, or combined.

(2) It is the only method of producing anæsthesia in which it is certain that the patient's muscles will become completely relaxed without danger. Most of us can recall struggling with a bucolic drayman with gall-stones or the 20-stone lady suffering from bronchitis and an immense umbilical hernia. Such cases render the deficiencies of ordinary inhalation anæsthesia painfully obvious.

(3) It is the only method in which respiration can be suspended for an indefinite time with safety. This is of immense advantage in operations upon the stomach, gall-bladder, lung, etc., where suturing is greatly facilitated.

(4) It is the only method of general anæsthesia in which the anæsthetist can, with safety, keep right away from the patient, knowing that whatever position the patient may have to assume, the airway will always be perfectly clear.

(5) It is the only safe method of anæsthetising patients for extensive thoracotomies in which both pleural cavities may be opened simultaneously, necessitating continuous inflation of the lungs.

(6) A modification of the method (by intra-bronchial catheter) is the only known means of safely anæsthetising

patients with an empyema communicating with a bronchus, so that the pus is not inspired into the unaffected lung.

(7) It is the only practicable way of administering a general anæsthetic for plastic operations upon the nose, mouth, face or neck.

(8) It is the only method of general anæsthesia whereby patients operated upon for acute intestinal obstruction can be carried to a profound degree of narcosis with no possibility of inhaling regurgitated material from the stomach and intestines.

Of these advantages the one which appeals most generally to the average surgeon is the second. It is of no little satisfaction to be certain that a completely relaxed abdominal wall will be the outcome of our administration, and as far as the writer is aware, the endo-tracheal technique is the only one which ensures this desirable result by eliminating all possibility of the laryngeal spasm which so often occurs during upper abdominal operations owing to peritoneal traction.

Disadvantages.

The disadvantages of endo-tracheal anæsthesia are few and can be stated briefly :—

(1) A heavy and somewhat complicated apparatus is necessary.

(2) The expense is somewhat greater than with the simpler forms of anæsthesia.

(3) A good deal of experience is necessary before the anæsthetist can be certain of introducing the catheter into the trachea quickly and without damage to the soft parts and the teeth.

Having discussed the advantages of endo-tracheal anæsthesia in general, the question may now be asked " why use gas-oxygen-ethanesal when air and ether can be given more simply ? " The writer has tried practically every combination of drugs and has come to the conclusion that the one indicated is the least toxic and gives the best results. Furthermore, the technique described below has the advantage that the degree of oxygenation of the blood can be regulated with some accuracy, whereas the use of air limits our control very con-

Photo of actual administration of endo-tracheal gas-oxygen-ethanesal, showing modified Boyle's apparatus.

siderably. The argument that oxygen is a pulmonary irritant can be discounted owing to the fact that it is diluted to practically the same extent as in air, but with nitrous oxide instead of with nitrogen. The fact that the former gas is itself an anæsthetic diminishes the quantity of ethanesal vapour which it is necessary to add to the mixture. It is impossible in this paper to indicate all the reasons why ethanesal is preferred to ether, but the writer recently determined to substitute ether as a control in 100 cases to see whether there was any appreciable difference in the anæsthesia and after-effects. When 20 cases had been completed it was obvious that all these patients had more severe post-operative vomiting than the previous ones, and therefore ether was abandoned. The persons making the reports had no idea that any change in technique had been made, so that a coincidence is extremely unlikely. It is not, of course, suggested that the gas-oxygen-ethanesal combination is incapable of improvement, and the writer is of opinion that the endo-tracheal administration of ethylene-oxygen is superior to it, but as this gas still cannot be obtained in sufficient quantity in England, the former method is recommended as the best that we have at our command at the moment.

Apparatus.

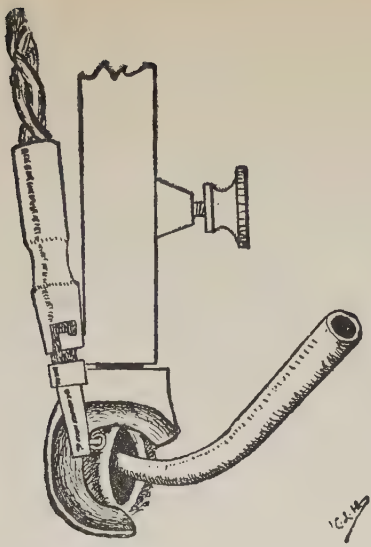
Any standard sight-feed gas and oxygen apparatus can be used without alteration for endo-tracheal anæsthesia, but it is desirable to add an extra anæsthetic bottle and pressure-gauge. The complete modified Boyle's machine can be seen in the photograph (kindly taken by Dr. Clausen), the small standard bottle being used for chloroform and the large tin container with pressure gauge, for ethanesal. Thus any desired combination and proportion of gas-oxygen-ethanesal-chloroform can be administered. Some anæsthetists consider that a safety valve blowing off at a pre-determined pressure, should be fitted. This is unnecessary on Boyle's apparatus as if, by misadventure, a sudden rush of gas should occur, the corks will blow out long before the intra-pulmonary pressure reaches a dangerous level.

A few words may now be said on the somewhat thorny subject of heating the vapour. At first sight this appears to be an admirable proceeding, but the specific heat of gases is

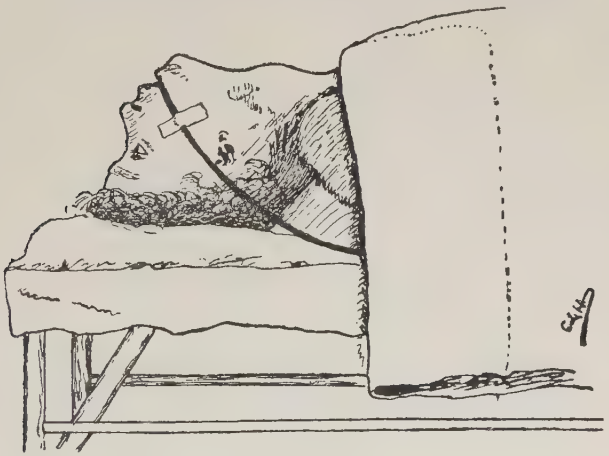
so low that some unlooked-for effects occur. After some investigation the writer has found that if a heater is placed on the machine itself and the exit-tube is more than six feet long, the temperature of the vapour issuing from the end of the catheter is only raised about 2 degrees above room temperature at a normal flow. To secure efficient heating the necessary apparatus must be quite close to the catheter, a circumstance which is usually most inconvenient. If no heater is in action the cooling effect of picking up the ethanesal vapour is lost after passage through about 5 feet of tubing, and the issuing vapour is then at room temperature. Finally, the gases are again heated during the 26 cm. of their passage through the catheter in the mouth, larynx and trachea so that they emerge at the bifurcation of the trachea at approximately body temperature. With an efficient heater interposed near the catheter it was found that patients always perspire, and apparently lose far more heat in this way than they gain by the vapour. Again, it is extremely dangerous to heat vapours containing any chloroform, since this drug when heated in the presence of oxygen tends to decompose into such substances as hydrochloric acid, chlorine, and carbonyl chloride, all of which are irritant and toxic. Finally, there is considerable divergence of opinion as to whether heated ether vapour is actually less irritating to the lungs than that at slightly under body temperature. As a result of these investigations the writer has now abandoned all extra heating.

Technique.

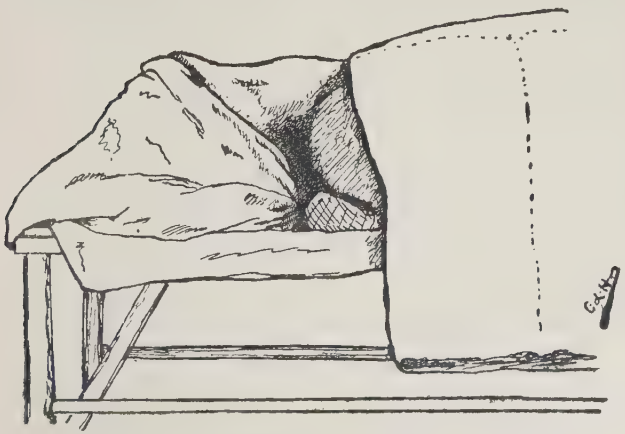
The patient is first given a full hypodermic dose of atropin about half an hour before the induction, and is then completely anæsthetised by an inhalation method. The writer generally uses ethanesal in a Clover's inhaler, but the method most familiar to the administrator should be employed provided that a sufficiently deep degree of narcosis can be obtained. The corneal reflex should be absent, and the jaw muscles completely relaxed before any attempt is made to introduce the catheter. For this reason pure gas and oxygen is unsuitable. Patients suffering from great tracheal obstruction should be anæsthetised with chloroform on a lint as this is less likely to increase the obstruction from congestion, saliva-



Passage of catheter by direct laryngoscopy.



Thyroid position with endo-trachael anæsthesia.



Thyroid position with towels arranged.

tion, etc. A rough but useful guide to the degree of obstruction is the character of the breathing when the patient is lying flat on his back. If he can then breathe deeply without much stridor or distress, ethanesal can be safely employed.

Difficulty in introducing the catheter can be avoided by attention to the following points:—

Firstly, as has already been indicated, the patient *must* be fully anæsthetised before the introduction is attempted.

Secondly, the patient's head should be exactly in the mid-line and resting upon one flat pillow. Many anæsthetists seem to think that hyper-extension of the head facilitates the introduction of the catheter. The writer has found that it invariably causes difficulty owing to the stretching of the soft parts, and furthermore, the practice is extremely dangerous when dealing with cervical and thoracic tumours causing respiratory obstruction.

Thirdly, a small direct-vision laryngoscope with a good distal illumination should be used. The epiglottis is first seen and pushed gently forwards, when the vocal cords will come into view. The instrument is then manipulated so that the glottis is in the centre of the visual field as shown in the sketch. If the patient is deeply anæsthetised the cords will be separated far enough to permit of the easy passage of the catheter. If, however, they are in a state of adductor spasm, a pause must be made until they separate. In no case must any force be used, and on the observance of this rule depends the freedom of the patient from post-operative laryngitis.

The distance which the catheter is passed is usually given as 26 cm. from the teeth, but the writer has found that 24 cm. usually gives a better result. The type of catheter used in ordinary cases is similar to the "railroad" urethral catheter, but in cases where one wishes to utilise one lung only (*e.g.*, in empyemata communicating with bronchi) a slightly smaller bicoudé catheter facilitates passage into the desired bronchus and is passed for a distance of about 29 cm. The catheter must be sterilized either in formalin vapour or by a brief boiling.

We now have to discuss the question of the *return airway*. In normal cases it is obvious that the gases escape back along the air passages and pass out of the nose and mouth. If,

however, these cavities are full of blood as in plastic and other operations in the neighbourhood, much bubbling will ensue, which may impede the progress of the surgeon. This can sometimes be avoided by packing, *e.g.*, in a plastic operation on the nose, the catheter is passed through the mouth and the naso-pharynx is completely plugged with a sponge to which a tape is attached. In most plastic cases, however, an *artificial return airway* is desirable. There are various ways of providing for this, but in the opinion of the writer the simplest and best method is to use a double airway catheter. This will be of slightly larger size than the normal single airway type (which averages 16 for an adult) and a length of rubber tubing can be attached to the proximal end of the return airway and led to a position where the escaping vapour does not incommode anyone in the theatre.

Having determined the correct size and distance for the catheter, it is fixed to the skin in any convenient position by adhesive plaster, and is connected up to the vapour supply. Unless the patient is very deeply anæsthetised some coughing will follow this proceeding. In most cases this will rapidly pass off as the gas-oxygen-ethanesal mixture gradually deepens the anæsthesia. If, however, coughing persists unduly, and time is an important factor, the ethanesal should be switched off temporarily and chloroform substituted until the patient is breathing quietly, when a change-over is again made. The proportion of oxygen for normal cases should be started at 25 per cent. and thereafter varied if necessary to keep the colour just pink. Observation of the mucous membranes is unnecessary and indeed impossible if the head is covered up with towels, but the colour of the venous blood in the wound gives the anæsthetist a fairly accurate guide as to its oxygenation. At a moderate degree of narcosis the pupil will be somewhat dilated, reacting sluggishly to light, and the corneal reflex will be absent. The pressure-gauge should register about +5 mm. Hg. on expiration, and 0 on inspiration. If a negative pressure is shown the rate of flow should be increased until zero is reached. An unduly high pressure usually means that the return airway is obstructed and if change of position does not rectify matters a change to a smaller catheter should be made.

If it is desirable to suspend respiration completely the endo-tracheal pressure should be raised to about 20 mm. Hg. This condition can be maintained for an indefinite time provided that no chloroform is being given and that a close watch is kept on the colour, blood-pressure and pulse-rate. In normal cases, however, slight breathing should be permitted, and as a rule, when the correct mixture has once been found, no alteration is necessary for a considerable time. In long cases it is often possible to run on gas and oxygen alone for considerable periods, and in all cases the ethanesal vapour should be switched off about 5 minutes before the end of the operation. It will then be found that when the catheter is removed all reflexes will have returned, and that all traces of ethanesal vapour will have been washed out of the lungs. Patients who are collapsed at the end of operation are often benefitted by the administration of pure oxygen for a few moments before the catheter is withdrawn.

Modifications of Technique.

The technique may have to be varied in the following conditions :—

(1) Cases in which the cautery (actual, electric or diathermic) is to be used on the face or mouth. The only modification necessary will be that the ethanesal vapour should be switched off at least 40 seconds before the cautery is applied. In a long cauterising, gas-oxygen-chloroform should be used.

(2) Operations conducted on the X-ray table, *e.g.*, removal of foreign bodies, setting fractures, etc. The endo-tracheal method is of especial value in these cases as the room being quite dark and extremely noisy, the anæsthetist has little guide as to the colour and respiration of his patient. The risk of explosion from stray sparks is, however, very real, and gas-oxygen-chloroform should be employed.

(3) Patients suffering from severe bronchitis, emphysema, etc., should be given gas-oxygen-chloroform.

(4) Certain plastic and other operations on the mouth in which the presence of the catheter impedes the work of the surgeon. These cases should be anæsthetised by the nasal endo-tracheal method. It is impossible in the confines of this paper to discuss the technique of introducing the catheter

through the nose into the trachea, beyond saying that the simplest method is to use a special pair of forceps (devised by Dr. Magill), although some anæsthetists prefer a probe fitting into a notch on a special catheter.

Contra-indications.

Endo-tracheal anæsthesia is contra-indicated in the following class of case :—

(1) New growths of the mouth, tongue and upper air passages. The writer is of opinion that the risk of introducing particles of growth on the end of the catheter with subsequent septic pneumonia is too great to be ignored, and that a preliminary laryngotomy should be performed. If the pharynx be then completely blocked with a sponge all chance of an inspiration pneumonia will be eliminated. Cases of carcinoma of the larynx will, of course, have to be anæsthetised through a tracheotomy tube.

(2) Babies below the age of one year. The lumen of the glottis is so small in babies that it is practically impossible to obtain a catheter of such size as will permit sufficient vapour to pass and yet leave an adequate return airway.

Results.

The results obtained in the first 1,000 cases may now be briefly summarised. The first 150 administrations were all in severe cases in which the endo-tracheal method was deemed to offer less risk than any other. The remaining 850 were routine major operations, including 250 partial thyroidectomies (the majority being for exophthalmic goitre), and 18 major thoracotomies, the rest being mainly abdominal sections and plastic operations on the face.

Anæsthesia satisfactory with no difficulty or complication in 972 cases (97.2 per cent.).

Deaths during operation, 1 (0.1 per cent.). This occurred during the decortication of a lung and was attributed to damage to the left vagus. It was a typically " reflex " death and was not considered to be due in any way to the anæsthetic. [This case was discussed in the Proceedings of the Royal Society of Medicine, 1923, vol. xvi.]

Pulmonary complications. (1) Fatal, 1 (0.1 per cent.). The operation was a splenectomy for splenic anæmia. The spleen was extremely adherent and several raw areas were left on the under surface of the diaphragm. Two days after operation signs of left basal pneumonia developed. The patient was in a very weak state and gradually succumbed. No post-mortem examination was permitted. Here, again, it is difficult to blame the anæsthetic.

(2) Non-fatal.

(*a*) Broncho-pneumonia, 2 (0.2 per cent.).
(*b*) Bronchitis—severe, 2 (0.2 per cent.).
(*c*) Bronchitis—mild, 10 (1. per cent.).

Post-anæsthetic laryngitis—mild, 4 cases (0.4 per cent.).

Post-anæsthetic pharyngitis, 8 cases (0.8 per cent.).

It may be thought that these figures do not show any appreciable improvement on those relating to other methods of anæsthesia, but nearly all the first 150 patients were extremely bad operative risks, and there is little doubt that if all had been routine cases the results would have been better. Furthermore, in the above list, four patients (one thyroidectomy and three thoracotomies) would, in the opinion of the writer and others, have died during operation if any other type of general or local anæsthesia had been adopted.

In conclusion it may be said that it is obviously impossible to discuss the method at all exhaustively in the scope of this article, but it is hoped that the few general principles which have been suggested may stimulate other anæsthetists to give it a fair trial for themselves.

THE ADVANTAGES OF WARM ETHER VAPOUR.

By Francis E. Shipway, M.D.

THE antiquity of warm ether is respectable. Lawson Tait[1] published in 1883 an account of an apparatus which he had devised for administering warm ether at a temperature of 33° C. in order to prevent the occurrence of bronchitis in old people. The routine method of administration advocated by him was that of dropping ether continuously on to a fold of a towel puffed out around the face at a distance of one inch or one inch and a half. The latter was obviously the forerunner of open ether, and the former of warm ether, but Tait's work was forgotten or not appreciated, and it was left to Davis and Gwathmey to lay the foundation of our modern knowledge of the advantages of this method. It is proposed in this article to bring these forward again[2] as briefly as possible, more especially from the point of view of the diminution of shock and of respiratory complications.

Among minor advantages are noted a more agreeable odour and a lessened irritation of the buccal and bronchial mucous membranes. Induction is more rapid and more smooth, and a successful administration can be conducted without a preliminary injection of atropine (*e.g.*, for catheterization of ureters). Respiration is more quiet and easy, and there is less vomiting, probably because less mucus and saliva are swallowed.[3]

Diminution of Shock.

Reference has already been made to the quieter type of breathing during a warm vapour anæsthesia. This factor is of importance in preventing shock as it represents a saving of energy by the nervous, respiratory and cardio-vascular systems. The chief factor, however, in the prevention of shock is the diminished loss of body heat. The importance of temperature in relation to anæsthesia is seen daily in the precautions taken to maintain the body heat of the anæs-

thetized subject. The regulation of the loss of heat and of the production of heat is abolished during deep anæsthesia; the patient becomes for the time being a cold-blooded animal. Consequently a fall of external temperature diminishes, a rise increases the production of heat. A normal man exposed to cold diminishes his loss by contracting the vessels of the skin and increases the production of heat by muscular activity. The anæsthetized subject has lost this control. Ether anæsthesia may increase the temperature of the skin owing to the dilatation of the vessels, but the loss of heat from this source may be so great that the internal temperature falls. Further, a rise in the internal temperature increases the excitability of the respiratory centre, a fall diminishes it; the heart also is stimulated by warmth, and the exchange of gases between the blood and the tissues is increased. This factor is of importance in view of criticisms to the effect that warming ether vapour does not save more than one calorie per hour.

It must be understood that it is not so much "the actual amount of heat which may be communicated to the patient but the effect of a high external temperature upon the production of heat in the body."[4]

The depth and duration of anæsthesia must be also considered, for it is obvious that deep anæsthesia will have a more profound effect than light, for the paralysis of muscles and the regulation of metabolism are in direct proportion to the depth of anæsthesia. Also prolonged anæsthesia is more detrimental than anæsthesia of short duration. There is consequently less necessity for the use of warm ether for short operations of slight severity, at any rate as far as the healthy adult is concerned, for he possesses a large reserve of heat at the start. On the other hand, in the case of children or of individuals whose resistance and vitality have been lowered by sepsis, trauma, starvation, anæmia or other causes, warm ether is definitely indicated.

Observations upon the superficial (thigh and forearm) and deep temperatures (rectal) during ether anæsthesia have been published by Pembrey and the author.[5]

Open ether and warm ether were used in 67 cases and 64 cases respectively, the two methods of administration being

similar in all respects, except that in the first, ether was dropped continuously on to the fabric covering the mask; in the second warm vapour was blown in under the mask at each inspiration. For full details the paper may be consulted, but it is pertinent to remark here that the greatest fall of rectal temperature in an adult, 2.4° F., occurred with open ether, whereas with warm ether the greatest fall was 1.0° F., and that in 37 cases of warm ether (adults) there were 6 of a fall of 1.0° F. compared with 24 cases of a fall of 1.0° F. or more in 41 cases. The difference in the case of children (4 weeks to 15 years) was equally striking. A few observations upon the temperature of the air under the mask were made; the range in the case of warm ether was 87.8° F. to 93.2° F., in the case of open ether, 48.2° F. to 86.9° F. The fear of producing hyperthermia led the author originally[2] to recommend a temperature of ether vapour ranging between 85-90° F., but subsequent experience in his hands and in the hands of Geoffrey Marshall in France during the war showed that vapour at a temperature of 100° F. can be safely administered in cases of shock. The author's records show no higher rise of rectal temperature than 2.8° F. in a child with a rectal temperature before anæsthesia of 98.6° F., and it is very unlikely that hyperthermia would occur in man, as the mass of the body, exposure during operation and vaso-dilatation would tend to prevent any serious rise.

Our conclusions show that "warm ether maintains the temperature of the body in a far more efficient manner than open ether. Thus with warm ether the respective percentages of rise, fall and no change of rectal temperature were 35.8, 44.5, 19.8 as against 16.6, 76.8, 8.6 with open ether." In other words, "the vitality and resistance of the patient are better maintained under warm ether."

Diminution of Respiratory Complications.

There can be little doubt that the irritating properties of ether play a considerable part in the production of these complications. The choice of anæsthetic for chronic bronchitics, or for those suffering from some sub-acute or acute lesion of the respiratory tract lies away from ether and in the direction of some less irritating agent. This is an admission

that ether is not wholly harmless. It can be rendered less irritating, that is less harmful, by warming the vapour. Also warming the vapour enables the anæsthetist to administer ether at a temperature under the mask which closely approximates to or actually reaches the temperature of the body. Dropping ether on to a mask lowers considerably the temperature of the inspired air. Further, warming the vapour, as we have seen above, tends to maintain the body heat in a far more efficient manner than open ether. For these reasons warm ether has been found to be of considerable value in lessening the liability to lung complications. Bowlby[6] has stated that during the war, when large numbers of men who were already suffering from bronchial catarrh had to be anæsthetized, ether could not be safely administered unless it was warmed, and he strongly advocates its use as a routine method in civil practice.

Marshall[7] noted that in the summer of 1915, of 50 men wounded in the abdomen and surviving more than 48 hours after operation under open ether, 54 per cent. had bronchitis: under warm ether in the summer of 1916 in a corresponding series of cases only 14.7 per cent. had bronchitis. In a communication to the author from France in April 1917, he stated that in one operating unit almost every one of the abdominal patients developed bronchitis after operation, and most of them died. Warm ether was being used but the temperature of the vapour was too low. After remedying this defect 15 of the next 25 cases did well, and not a single one developed bronchitis.

Bigger[8] and Smith[9] speak well of the method; the latter attributes a low proportion of serious pulmonary disease in a series of cases to the use of warmed ether vapour, as prior to its introduction lung complications were considerably more frequent.

Ross[10] thinks that warmed vapours are of benefit in preventing pulmonary complications. The author knows of no series of cases which prove the contrary. It is true that McCardie[11] does not think that warming the vapour has much influence in lessening the liability to lung complications, but it is of interest to note that he lays stress upon the value of respiration through the nose in preference to the mouth on the ground that "the vapour is warmed," and fancies that lung

complications "are less likely to occur after a closed than after an open administration."

Better results can be obtained with the apparatus which the author devised[2] if attention is paid to the following points:

1. The rubber tubing leading to the mask must not exceed 30 inches.
2. No metal connections should be used between the tubing and the mask.
3. The temperature of the vapour entering the mask should lie between 90° and 100° F., according to the type of operation and condition of patient.

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EDITORIAL.

Some Remarks on Post-operative Lung Trouble.

THE intra-thoracic complications that occasionally follow operations offer a problem both to surgeon and to anæsthetist. At present the exact causation of the mischief is often quite unknown. In fact it is often open to doubt whether the anæsthetic or the operation itself is the chief agent in originating subsequent lung trouble. Nevertheless the common assumption is that the anæsthetic is always to blame for these sequelæ. Indeed when ether has been the anæsthetic employed its evil influence upon the respiratory passages is taken for granted and when a comparison is made between this drug and chloroform in point of safety the argument is constantly advanced that though chloroform may lead to death on the table ether is equally dangerous because of the deaths that it causes after operation through "ether pneumonia." Yet when the facts are sifted and evidence for this contention is sought for we find that it is hardly forthcoming. On the contrary we find that deaths through chest complications after operation have been associated with all commonly used anæsthetics. This is true not only of inhaled anæsthetics. These "pneumonia" fatalities have occurred with remarkable frequency after spinal anæsthesia and after purely local anæsthetics. It is clear then that by christening these cases "ether pneumonia" we are begging the question and we are disguising the true facts. Some factor other than the inhaled anæsthetic is obviously involved in the causation of post-operative injury to the lungs. It seems that what is needed in order to clear this matter up is firstly a statement of all the factors involved, and secondly an extended organised investigation designed to settle the relative importance or unimportance of these various factors. In this way it may be possible to narrow down the probable sources of the trouble to one or at the most two main factors, and then our procedure could be carefully designed to obviate these. A broad review of one's own experience of the many reported instances of post-

anæsthtic lung complications leads to a recognition of the following factors as being involved. Any one of them may turn out to be the most important causal agent.

(1) In the first place one would put the site of the operation, because at present that appears to be the most important of all the factors involved. The overwhelming proportion of abdominal operations over all others, except those involving the air passages themselves, is the first striking fact revealed by a study of large numbers of cases of post-operative respiratory trouble.

Space does not permit of a discussion of the way in which an abdominal operation may lead to subsequent lung trouble. Pasteur's admirable work on "massive collapse" has given a clear explanation for many cases. Others are instances of broncho-pneumonic consolidation probably from blocking of small bronchioles and deficient respiratory movement.

(2) Inspiration of organisms, or of material containing them, from the mouth or pharynx. It is here that ether, unless preceded by atropine, is held to play its part through promoting excessive secretion of mucus and saliva some of which may be inhaled with contained germs. Ordinary oral sepsis, which is so common and often so disregarded, must here be borne in mind. In this category come too cases of pneumonia after such operations as excision of the tongue for cancer, when the breath may have to pass over a raw septic surface subsequent to operation.

(3) Pulmonary infarcts. Many cases of "ether pneumonia" have been shown to be really small patches of consolidation subsequent to the infarction of a small embolism derived from some vein ligatured at the operation. These cases are stated to occur most frequently in association with the operation for radical cure of hernia and with pelvic operations.

(4) Pre-existing respiratory lesions. Here one must lay stress on the frequency with which a common cold is afterwards revealed when, lung trouble having followed operation, searching inquiry is made for the cause. Similarly persons recently convalescent from influenza or like affections may be harbouring the specific germ and this may spring into damaging activity when helped by the lowered resistance of

the body, but is almost certain to be caused temporarily by the performance of an operation and the subjection to an anæsthetic. Pre-operative bacteriological investigation should help us to avoid this class of case.

(5) Exposure to chill. It is a common belief that lung complications are much more frequent in hospital practice, when patients have of necessity a considerable little journey from table to bed after operation, than in private practice where it is easier to avoid any exposure of the patient to draughts, cold air or change of temperature.

(6) Direct irritation of air passages by the anæsthetic. Probably ether is the only anæsthetic that can cause trouble in this way. Whether it ever actually does so in practice unless the patient is already affected by coarse bronchitis or other respiratory affection, is still unproven. Experimentally of course the possible damaging effect of ether on the lungs has been shown. The conditions, though, as regards length of administration or concentration of vapour did not coincide with those of the clinical use of ether, and it is doubtful to what extent the laboratory conclusions may be justly applied to human surgery.

(7) Secondary sepsis. When the lung trouble starts more than four days after operation it can generally be dissociated from the anæsthetic. In these cases, which are often grave, the respiratory complication is almost always due to sepsis in connexion with the operation. J. Blomfield.

Reciprocity between Surgery and Anæsthesia.

Members of the profession who have been engaged in our specialty for some years past can hardly fail to appreciate the improvement which has taken place in the relationship between surgeons and anæsthetists, and it will be admitted that the science or art of anæsthesia is so closely allied to that of surgery that without co-operation progress would be impossible. As a matter of fact so intimately do the interests of these two specialties overlap that there is a risk of responsibilities being unwittingly placed upon the wrong shoulders, with the result that progress is sought in the wrong direction. The feeling which prompts these remarks is a consciousness of the debt owed by anæsthesia to surgery, and a desire to

determine at what points friction may still be impeding advance.

The mode of preparing patients for operation varies in different clinics and the matter is apt to be left to routine without due consideration of the factors peculiar to individual cases. The argument is often used that cases of emergency generally show but little tendency to be upset by the anæsthetic although they may have had no preparation, but such results, in reality, support the teaching of anæsthetists who advocate the avoidance both of violent purgation and of too sudden a change in diet, especially where this had consisted largely of carbohydrates, as in hospital cases.

During the course of operation perhaps the most likely bone of contention to arise between surgeon and anæsthetist is the problem as to the level at which anæsthesia ought to be maintained, the interests here involved being often so antagonistic that they call for the most unbiassed consideration. Faulty administration will lead to prolonged and harmful manipulation, just as surely as unskilful handling of the tissues will render artistic anæsthetisation an impossibility. The administrator's plausible attempt to avoid unnecessary saturation with a toxic drug may easily be frustrated by the operator's demand for an unwarrantably deep degree of narcosis, whereas a much lighter degree might be quite satisfactory if the surgical technique were suitably altered or if local analgesia were combined with general anæsthesia.

For many reasons it might be an advantage if the anæsthetist could take a more active share in the care of patients after operation than is the custom generally, not necessarily to make suggestions as to treatment so much as to have impressed upon him the effects of his administration so that he might judge the better what modifications in technique were desirable from his point of view.

Many such " friction points " could be cited, but the above have been selected as illustrating how dual responsibilities may call for singular tact. A. L. Flemming.

To Obtain Proper Relaxation.

Relaxation of the upper abdomen has been the bugbear of many anæsthetists for quite long enough, and any method

that will be of assistance in producing really good relaxation is well worth trying.

It has been known for a long time that endo-tracheal ether can and does produce perfect relaxation of the upper abdomen, but it is only recently that working in conjunction with my colleague, Dr. Langton Hewer, we have evolved a technique which in our opinion is better than endo-tracheal ether.

The combination that we use is either gas-oxygen-ethanesal or gas-oxygen-ethanesal-chloroform.

The patient is anæsthetised in the ordinary way with one or other of the combinations, and taken to fairly deep anæsthesia, the stage one tries to arrive at is relaxation of the jaw muscles, then with the head in the middle line and not hyper-extended a direct vision laryngoscope is passed into the mouth, the epiglottis is tipped forward and a catheter inserted into the larynx. Great care must be taken to carry out this with absolute gentleness for if any force is used there will be bruising and subsequent tracheitis.

Anæsthesia is now maintained by giving one or other of the aforementioned combinations via the catheter, and we find in a large number of cases after the anæsthetic has been in progress for about 15 minutes that gas and oxygen alone are sufficient to maintain adequate anæsthesia, with complete relaxation of the abdominal muscles.

As with endo-tracheal ether anæsthesia the breathing can be entirely suspended, but this is only necessary in a very small proportion of the cases.

Proficiency in this method is readily obtained by any one who has been in the habit of using endo tracheal ether, and it is only necessary to sound a note of caution with regard to the addition of chloroform to the mixture. When this is done the anæsthetist must proceed with great care, using as little of the mixture as possible.

The uniformly good results which have been obtained with this method lead one to think that it might be more widely tried for the difficult upper abdomen. H. Edmund E. Boyle.

The Anæsthetist's Dilemma.

This dilemma faced me recently in the case of a boy, aged 12, with acute appendicitis. He was well developed and, up

to the time of his attack, healthy, with the exception of a rather acute "cold in the head." The question arose, should I administer ether and risk respiratory sequelæ, or chloroform and risk acidosis? I chose the former alternative, and, beyond thirty drops of chloroform during induction, administered ether throughout, giving the warmed vapour from a Bomb led to a mask of the Ogston type. As slight cyanosis developed about half way through, a gentle flow of oxygen was also led to the mask till the finish, the cyanosis rapidly disappearing. The administration lasted for 28 minutes. The appendix was distended, turgid, and kinked, but not gangrenous. The operation presented no unusual features. Twenty-four hours afterwards the patient's temperature commenced to rise, and accompanying this the breathing became rapid and laboured. Eight hours later the patient had all the symptoms of pneumonia; temperature 103.4, pulse 128, respirations 60, short dry cough, embarrassed breathing, and slight cyanosis. Physical examination revealed a left basal pneumonia. This proved to be the height of the attack, and from this time his temperature gradually fell and his other symptoms subsided. Recovery was uneventful and complete.

In making a decision as to the anæsthetic to employ in such a case the anæsthetist has to make up his mind which is the lesser of two evils. (Parenthetically gas and oxygen with local analgesia was probably the method of choice, but in this particular instance I was unable to use it, and it is not always available.) He must decide whether he will risk acidosis which so frequently follows chloroform anæsthesia in acute abdominal conditions, especially in children; or lung complications, which are also more prone to follow ether anæsthesia in children than in adults. In this particular case the abdominal condition proved to be comparatively slight, in that there was no suspicion of gangrene or abscess, and therefore less risk of acidosis. On the other hand I did not know this till the abdomen was opened. The symptoms in such cases are so often deceptive. At any rate the case brought very insistently to my notice a problem which must frequently arise, and one on which the Editor might perhaps allow space for discussion.

H. P. Fairlie.

THE PREVENTION OF POST-ANÆSTHETIC DISCOMFORT.

Some years ago I suggested to the late Mr. Nicoll, surgeon, that the addition of veronal to the rectal salines given to patients after abdominal operations might help to ensure a calming effect and prevent to a certain extent distressing sickness and uneasiness experienced especially after prolonged anæsthesia. The ordinary veronal preparation we found difficult to dissolve although it does so in very hot water, but we obtained much better results with sodium veronal which is readily soluble. After its administration patients could be kept for several days in a more or less drowsy condition and then wake up with no sickness in comparative comfort. The procedure was as follows:—Shortly after the patient was carried from the operating theatre to bed a warm rectal saline of three ounces was given containing 10 grains of sodium veronal, and this was followed every four hours thereafter by a saline containing 5 grains of veronal. If stupor became more than was desirable the veronal could be left out and given alternately. Naturally one can never say how any patient may respond to any drug, so careful observation is requisite. I have found that the best results were obtained in highly neurotic subjects as they are a class who directly they come out of anæsthetic start to retch and make no effort to restrain the tendency to sickness. This applies not only to patients who have had ether or chloroform but also to cases who have had prolonged nitrous oxide and oxygen anæsthesia. I recall a case of a patient who had five abdominal operations and every time had burst the stitches owing to sickness. She was put on veronal after a further operation for excision of the gall bladder and slept for the best part of three days and woke up feeling comparatively well and no sickness. One advantage of rectal administration is that the patient can be kept unaware that any drug is being given. I think that is often an important factor in nervous subjects, for if they get a hypodermic say of morphia, often start worrying in case it may upset them and thus destroy any of the desired good effects.

I have never heard of any untoward results following this treatment, though the stuporous effect produced might cause alarm to any one unaware that it was being employed.

J. PATON BOYD.

ABSTRACTS OF CURRENT ANÆSTHETIC LITERATURE.

La Pressé Medicale, 24th Oct., 1923.

The surprises of chloroform. By L. Cheinisse.

In recent investigations into the chemical aspects of anæsthesia a Swiss worker, E. Baumann, has come to the conclusion that in a large number of accidents associated either immediately or remotely with the administration of an anæsthetic, the cause is to be traced to a change of a chemical nature having taken place in the drug.

As an illustration he quotes a case reported by Sigal, when a woman, aged 30, was operated on in the Odessa Hospital for appendicitis. The operation lasted 40 minutes, and 50 grms. of chloroform were used; soon after the operation uncontrollable vomiting set in, and two days later the breath still smelt of chloroform and jaundice was noticed, this symptom increased and, coma supervening, the patient died in spite of remedial measures. Three days later, in the same hospital, another woman, also operated on for appendicitis, developed the same train of symptoms, but in a milder form; there was general jaundice, but the patient slowly recovered although some of the symptoms persisted for a long while.

The autopsy on the first patient revealed fatty degeneration of heart, liver, and kidneys.

Samples of the chloroform were analysed and were found to contain organic impurities as well as aldehyde. About this time Sigal learned that accidents, similar to his own, had occurred in different parts of Russia, and as a consequence he was led to examine a number of samples of chloroform. In one American specimen he found organic impurities, aldehyde, and phosgene; and another also contained phosgene; these were both in tin receptacles, apparently from war stocks, a factor which has obtained in the case of many accidents occurring in Russia.

Baumann recommends the following two tests:—

1. Nitrate of silver. No precipitate.
2. Sulphuric acid with trace of formalin. No discolouration.

A Belgian surgeon, H. Magos, has reported four cases who developed cyanosis and tonic spasm of the jaw muscles, with marked respiratory depression when anæsthetised by a specimen of chloroform in which analysis failed to determine what was the nature of the change or impurity present.

La Pressé Medicale, 3rd Nov., 1923.

Poisons which paralyse the sympathetic. By BINET.

Atropine is recognised as a paralysing poison of the vagus system, nicotin of the sympathetic, and adrenalin an excitant of the latter. Swedish physiologists, Backman and others, suggest that atropine is capable of acting on the sympathetic system. And Fredericq and Bardier show that caffein acts as a paralyser of the sympathetic.

Experiments. Backman showed that the contraction caused in an isolated portion of blood vessel, by placing it in a solution of adrenalin, was checked or prevented by the presence of a small quantity of atropine. In the cat, the rise in blood pressure caused by adrenalin was diminished by previous atropinisation.

Béco and Léon Plumier have shown that caffein, by local action, modifies the calibre of vessels, those of the kidney and of the paw becoming markedly dilated. Fredericq and Descamps found that caffein prevented the vaso-constriction and pupil-dilatation which normally take place when the sympathetic of the neck is electrically stimulated.

Other experiments showed that caffein and adrenalin were antagonistic in their action on intestinal circular muscle fibres.

Bulletin de l'Academie de Medicine, 20th Nov., 1923.

Prevention of post-anæsthetic vomiting. By R. BLONDEL.

Vomiting following general anæsthesia is of sufficient importance to warrant our every effort to obviate it.

It is admitted nowadays that vomiting is not to be attributed to the chloroform which may be swallowed with saliva; in the first place this is very small in amount and, moreover, chloroform water is a recognised sedative in cases of nausea and vomiting. Post-anæsthetic vomiting must be regarded as a result of serious injury done to the liver cells by the fat-solvent chloroform brought to the organ by means of the blood stream, and we find that mixtures produce less harmful effects in proportion as they contain less chloroform or ether and as these drugs are replaced by ethyl chloride and alcohol. An unhealthy state of the gastro-hepatic apparatus is probably in most instances the determining factor in cases of alleged chloroform idiosyncrasy.

Since it has been recognised that fasting and purgation may themselves produce acidosis, the method of preparing patients for operation has been modified, and in certain American clinics they are fed freely to within four hours of taking the anæsthetic; but in France the custom is to have recourse to a milk diet with lavage of the bowel.

Departing from the orthodox I have made it my principle to suppress in food all albumen of animal origin, also fats and alcohol, that is to say, any article of diet calculated to impose undue work upon the liver cells; milk has been abandoned because of its casein

and butter; I give for three or four days a régime composed exclusively of bread and fresh fruit, with water, tea, and coffee for drink; with the addition of 8 grammes of citrate or bicarbonate of soda per diem dissolved in aerated water. Each evening the bowel is copiously lavaged.

The result of this routine has been an almost complete freedom from post-anæsthetic vomiting. A. L. Flemming.

Rassegna Internazionale di Clinic e Terapia, Anno iii, No. 12.

Dr. R. Riccio has issued from the University of Naples a pamphlet on *points of election for trunk anæsthesia of the sciatic* (peri- and endo-nervous). He employs solutions of novocain from $\frac{1}{2}$ to 3 per cent. which he prefers to make up immediately before use either with distilled water or physiological saline solution, and to them he adds 20 to 25 drops of one in a thousand adrenalin to each 100 cc. of solution. The most simple and least dangerous points at which to make sciatic injections were determined by anatomical dissections and injections of Prussian blue. The gluteal region and the popliteal region are selected. In the first the point of injection lies at the centre of a line drawn from the last sacral vertebra (1.2 cm. above the top of the anal cleft) to the upper margin of the great trochanter. The point in the popliteal region is at the middle of a short line going from the tendinous edge of the semitendinosus to that of the biceps immediately behind the upper angle of the popliteal triangle. With the gluteal puncture the nerve is found at a depth of 2 to 3 cm. according to the individual. The needle is inserted directly on to the sciatic.

Dr. Riccio made a number of experimental injections on dogs before applying his method to the human subject, and the results of these injections are tabulated in the paper here summarized. It was found that perinervous injection, although of course easier in performance, produced an anæsthesia which was less lasting but took longer to appear than that from injection into the nerve trunk itself. An injection of 5 to 10 cm. of 2 per cent. novocain with adrenalin gave an anæsthesia lasting 40 to 50 minutes. The endonervous injections may be, according to Dr. Riccio, either beneath the sheath or into the nerve fibres, and the symptoms produced vary according to which of these sites is injected. Paræsthesia and difficulty of diffusion of the solution distinguish the intrafibrillary injections from those that go merely beneath the sheath of the nerve.

The gluteal injection is made with the patient in the sitting position; for the popliteal he lies prone. Occasionally there is a brief period of shock after the nerve is pierced and this has also been seen during the recovery period after operation. Caffeine injection is recommended as the best treatment.

In "Il Policlinico" Professor Lieini gives some details of his

experience with 300 *cases of spinal anæsthesia.* Among these he had 22 instances of retention of urine, of which 21 were after hernia and one after a hydrocele operation. For the treatment of lowered blood pressure he employed caffein or camphorated oil by subcutaneous injection and obtained good results. The author does not employ spinal for any person with tubercle or other specific infection, and not for children under fifteen years of age.

Dr. B. Quarella contributes to " Il Policlinico " of November some *observations on splanchnic anæsthesia.* He employed the method for eight gastroenterostomies, of which four were on patients with malignant and four on patients with innocent stenosis. Scopolamine and morphia or morphia alone were injected beforehand; the posterior route was used for reaching the splanchnic area with the novocain solution. Twelve operations were performed with splanchnic anæsthesia, and of these the insensibility is described as perfect in eleven and mediocre in one. Bilateral injection was practised in ten, unilateral in two cases. Inflammation of the cellular retroperitoneal tissues and adhesions may interfere with the normal diffusion of the anæsthetic solution and thus cause imperfect anæsthesia. The condition of the patients during severe operations and after compared most favourably with that seen during and after narcosis. The percentage of failures, requiring the assistance of a general anæsthetic, is reckoned by Quarella as about 10 per cent., taking into consideration the results of all those who have reported their cases. Increased experience with the technique will, he believes, reduce this proportion. Injury of the great vessels he finds to be almost impossible, without gross technical error or pathological alteration of the anatomy of the parts approached. Before making the injection the piston of the syringe is always to be withdrawn a little. If blood is then aspirated into the syringe the needle is held to have entered a vessel and is withdrawn somewhat and re-inserted before the injection is made. Acute intoxication from stovaine has twice been reported after injection into the vein. The addition of adrenaline to the novocain is regarded as indispensable. Professor Lieini employs the posterior route of approach, after Kappis.

Dr. Brunicardi in the same journal describes and illustrates an elaborate *apparatus for keeping the lower jaw forward and the mouth open* during general anæsthesia. It is fixed to the back of the head and neck with a pad exerting pressure behind the angle of the jaw and a spring attachment ending in a splint prop to hold the mouth open.

A *history of regional anæsthesia* and a condensed acccount of its application to the various limbs and other portions of the body are given in " Rassegna Internazionale di Clinic e Terapia," Naples, 1923.

J. Blomfield.

Amer. Journ. of Surgery, Anæsthetic Supplement, July 1923.

The anæsthetist's point of view. Wm. Webster.

Shock prophylaxis. Charles J. Wells.

*Methods of teaching general anæsthesia to dental students. E. W. Martindale.

*Post graduate in anæsthesia for dentists. Henry I. Dorr and Theodore D. Casto.

The value of pressure control re-breathing in ether anæsthesia. J. J. Vega.

Synergistic analgesia. Frank D. Smythe.

The problem of service in the relation of the professional anæsthetist to the surgeon. Ansel M. Caine.

Methods of teaching general anæsthesia to dental students.

In describing the work in the Dental College of the University of Ohio, the author, who occupies the Chair of Instructor in Dental Anæsthesia, details the course required of all students. In the first, second and third years the instruction is given in connection with the departments of organic chemistry, physiology, and dental pathology, and in the fourth and final year one recitation and three clinical hours each week are given over to practical anæsthesia, local and general, in their application to the various needs of dental work.

In the class room the students " are carefully taught the physiological and toxic effect of all the general agents used; how to select the proper anæsthetic with consideration to sex, age, temperament, physical condition, nature and length of operation; how to meet and care for and instruct the patients to gain their confidence; also, how to personally attire and prepare themselves, and prepare the chair, equipment necessary for any emergency, and the operating room; the necessity of quiet assurance and confidence and their effect upon the patient."

Post graduate work in anæsthesia for dentists.

The writer, in this paper, believes that classes should be limited to five graduates, and should include those only who have been in practice several years. An important part of the course is to have each member take small doses of gas-oxygen himself so that he shall know, by personal experience, the physiological effects of the anæsthetic. In a class of five as a working team he gives the following outline of a session's work.

Student 1 should hold the mask and give the gas.

Student 2 should count the pulse and take the blood pressures every three to five minutes and record his findings on a chart, indicating every change to the second.

Student 3 should count the respirations and make records to the second, with general observations as to the conditions of the patient and the procedures in their exact sequences. His chart should show when analgesia, anæsthesia and cyanosis occurred.

Student 4 should arrange the instruments and do whatever is required of him, with ease and dispatch.

Student 5 should be made captain of the clinic. He should assist in every way at the operation and see that each one is supplied with the particular appliance he may require.

GENERAL ITEMS AND NOTES.

Dr. G. E. Macoie has been appointed Honorary Anæsthetist to the Bradford Royal Infirmary.

The Seventy-seventh anniversary of Ether Day was celebrated at the Massachusetts General Hospital, Boston, on October 15th and 16th.

Mr. S. R. Wilson, F.R.C.S.E., delivered a post-graduate lecture at the Manchester Royal Infirmary, Nov. 14th, taking as his subject "Recent Improvements in Anæsthesia."

Soupault and Boulanger-Pilet, in the *Paris Médical*, Sept. 29th, 1923, mention a case of meningitis following lumbar intraspinal anæsthesia which, however, recovered in eight days.

The Laryngological Section of the Royal Society of Medicine held a joint meeting with the Anæsthetic, Odontological and Otological Sections on Dec. 7th at which "The Comparative Value of Cocaine Substances" was discussed.

On the programme of the Congress of Anæsthetists, Chicago, Oct. 22—24, Mr. Z. Mennell, M.B., M.R.C.S., of London, was down as the representative of the Section of Anæsthetics, Royal Society of Medicine, to read a paper on "Anæsthesia for Intracranial Surgery."

C. Ritter, in an article in the September 8th *Zentralblatt für Chirurgie*, points out that by compression of the carotid arteries at the inner margin of the sternocleidomastoid muscles anæsthesia with ether may be hastened by producing cerebral anæmia.

The following officers were elected at the annual meeting of the National Anæsthesia Research Society held in Chicago, Oct. 22—24th: President, W. I. Jones, D.D.S., Columbus, Ohio; Vice-Presidents, Drs. John H. Evans, Buffalo, N.Y., and Arthur E. Guedel, Indianopolis; and Secretary-Treasurer, Dr. Frank H. McMechan, Avon Lake, Ohio.

At the Birmingham Meeting of the Anæsthetic Section, Royal Society of Medicine, Dec. 1st, Dr. K. B. Pinson of Manchester exhibited the apparatus with which he had conducted experiments in the condensation of dimethyl ether. This substance at normal pressure and temperature is a gas. He found that it boiled at $-24°C.$, and that at 100°C. it exerted a pressure of 97 lbs. to the square inch, and could thus be safely stored in cylinders.

At the recent Congress of the Associated Anæsthetists at San Francisco resolutions were passed committing themselves to the development and extension of the specialty of anæsthesia and the standardization of anæsthetic service in the hospitals of the United

States and Canada. A committee is to be formed to collaborate in compiling and publishing a pamphlet to bring to public attention the importance of such an innovation.

The new terms of service for insurance practitioners, commencing as from Jan. 1, 1924, make the doctor responsible for providing the service of another practitioner for the administration of an anæsthetic, when necessary, in connection with an operation undertaken under the terms of service. Exception is made in the cases of those who, as a result of special skill and experience, may be placed in the category of specialists.

The Supreme Court of Pennslyvania, in the case of a claim under the Workmen's Compensation Act, affirmed an award for compensation for a death under anæsthesia which was administered for treatment of a compound fracture of the right index finger. The Court held that the injury caused the operation, the operation required the anæsthesia, the anæsthesia brought about dilatation of the heart, and the latter caused the death, thus establishing a causal connection between the original violence and the death which ultimately resulted.

E. House (*Am. Journ. Surg. Anæst. Supplement,* Oct. 23), in an article on Scopolamin Anæsthesia in Criminology, claims that he is able, by the use of this drug, " to secure from the mind, against its will, the stored contents called memory." He states that, since the hearing centre is the last to succumb to an anæsthetic and the first to function after its discontinuance, it is but necessary to put a question to an individual at this exact period, that is, at the moment the auditory centre asserts its power, to elicit a truthful reply, the individual being too helpless to protect himself by inventing lies to the question propounded. He calls this period of borderland anæsthesia the *receptive stage.* Scopolamin, he asserts, is peculiarly fitted to produce this state of mind, and he gives instances where criminals related facts which, though against their own interests, were later checked by verifying testimony. He believes that its judicial use might also prevent the miscarriage of justice in the case of innocent victims.

In a paper on Obstetric Analgesia (*Journ. A. M. A.,* 29, 9, 23) Danforth and Davis conclude that ether, unless contraindicated, is the inhalation anæsthetic of choice for the longer operations during pregnancy and labour. Nitrous oxid-oxygen may be used for examinations and short operations, as well as for intermittent analgesia during the second stage of labour. They believe that chloroform should be " completely discarded."

In a paper on Local Anæsthesia, same journal, Farr sums up the important features necessary to success in that method as including " attention to the psychic condition of the patient; the establishment of careful pre-operative diagnosis; the painless, thorough induction

of anæsthesia of the abdominal wall; elastic retraction; perfect exposure; the establishment of anterior splanchnic anæsthesia, when indicated; the enlistment of the patient's co-operation, and the application of a surgical technique that is compatible with this method of anæthesia and the best interests of the patient."

Bonar and Meeker of Rochester, in their paper on Sacral Nerve Block Anæsthesia in Obstetrics (same journal), state that labour pains may be entirely controlled by block of the second, third, fourth and fifth sacral, and anococcygeal nerve, the epidural method being most practical. Also most operative and manipulative obstetric procedures may be painlessly performed under sacral nerve block; the only drawback being the comparative shortness of its duration.

Dr. Henry Featherstone communicated a critical report on 100 cases of spinal analgesia with tropacocaine, at the Nov. 2nd meeting of the Anæsthetic section, Royal Society of Medicine. The author's conclusions were as follows:— (1) Patients suffering from diseases of lungs, heart, kidneys, chronic toxæmia and diseases of metabolism may well be treated by intrathecal methods. (2) The presence of acute traumatic shock is a contraindication. (3) The method does not prevent abdominal shock associated with severe handling of a viscus above the colon without very high paralysis. (4) Exhaustion from manipulation of the pregnant uterus in labour and of the pelvic organs in general is rarely seen. (5) Association with light general narcosis is most helpful. (6) Early post-operative headache rarely occurs with tropacocaine, provided that there is little loss of cerebrospinal fluid. (7) The most careful handling of these cases is needed if a considerable fall in the blood pressure is to be avoided. (8) Late complications attributable to the spinal anæsthetic are extremely uncommon in the absence of infection.

Dr. T. B. Vaile will deliver a post-graduate lecture at the Cancer Hospital, Kensington, S.W., on "Surgical Anæsthesia by Nitrous Oxide and Oxygen," at 4-30 p.m., Feb. 13th.

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(See also Abstracts in Current Anæsthetic Literature).

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"Practical Anæsthetics." H. Edmund Boyle and C. Langton Hewer. Oxford Medical Publications. Third Edition, 1923.

This little volume is a practical condensation of the latest teaching in anæsthesia, and brings the subject right up to date. It should prove of value not only to the physician who desires to keep well informed, but to the specialist who finds it advisable to "brush up" at short intervals. The authors have succeeded in making the subject matter interesting (a task not always an easy one) and at the same time the reader feels that the points dealt with are explicit and authentic. Particularly useful are the chapters on "Special Methods of General Anæsthesia," and "Local and Spinal Analgesia," for those who find it necessary to venture from the straight and narrow path of ordinary anæsthesia.

The chapter on "Nitrous-Oxide" carries with it the full weight of the highest authority.

The volume is compact, and neatly printed.

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SNOW'S WORK ON CHLOROFORM.

By Dudley Wilmot Buxton, M.D., B.S., M.R.C.P.,
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On the 10th November 1847, Dr. J. Y. Simpson, as he then was, communicated to the Medico-Chirurgical Society of Edinburgh his paper entitled "Notice of a New Anæsthetic Agent as a Substitute for Sulphuric Ether in Surgery and Midwifery." It was dedicated to M. J. Dumas, the eminent French chemist, and sets forth in a concise manner Simpson's first experiences with chloroform. In a private letter sent by him to Dr. Prothero Smith, to whom he had sent a proof copy of the pamphlet, he writes: "Here [*i.e.* in Scotland] we are all *wild* on the subject." The wording of the paper, however, is free from exaggeration and contains little information about the great discovery. It states that chloroform is exempt from the disadvantages of ether as then administered; that no inhaling apparatus is required, and that in tooth extraction and minor surgery, as well as in a few cases of midwifery, this agent had been employed, and found to be conspicuously successful. A few words borrowed from manuals on chemistry are added, which describe the pharmacological aspect of "perchloride of Formyle," and that is all. The plan of administering the drug suggested is to pour "a little of the liquid diffused upon the interior of a hollow-shaped sponge or a pocket-handkerchief or a piece of linen or paper and held over the mouth and nostrils." This method Simpson adhered to in his later papers. He used half a drachm, and, puckering the handkerchief into the shape of a cup, he at first held it half an inch from the face,

later applying it close to the mouth. In none of the succeeding papers do we find any attempt to explain the physiological action of this narcotic, or to trace the best method of preventing overdosage. Indeed, it would seem that although Simpson definitely stated that danger and even death may follow its employment, yet such contingencies were, in his view, highly improbable, and were due to lack of knowledge on the part of the administrators. When several deaths were recorded Simpson wrote explaining them away and in many cases asserting that the fatalities were due to causes other than the action of chloroform. It is remarkable that in the history of anæsthesia we find that those who were enthusiastic about certain agents or certain methods have been prone to gloss over the accidents which to the plain man appear to be the direct result of the agents or the methods of their employment.

Thus was initiated the unscientific system of the use of chloroform, "unmeasured chloroform, but plenty of air," a system which the reputation of Simpson and the vigorous advocacy of Syme and those who followed him rendered almost a cult. It must be remembered that fatalities were at first few, while of these many were attributed to any cause other than an overdosage by chloroform. This state of things could only have arisen through neglect of the study of the action of the drug upon the animal organism. The surgeons of those days, with whom the use of chloroform rested, it is true, were giants, but they were not physiologists.

Snow, as we have seen, was a thinker, and one who preferred to seek truth by experiment rather than to be led away by enthusiasm. As soon as Simpson's historic pronouncement on chloroform was made common knowledge, Snow commenced his exhaustive research on "Narcotism by the Inhalation of Vapours." This was published in the *London Medical Gazette* in 1848, and took cognizance of ether, chloroform, Dutch liquid, bromoform, bisulphide of carbon and many other bodies. Of these we need only pursue the work which dealt with chloroform.

Snow, in his experiments upon lower animals, set himself to discover what was the effect of different percentage strengths of the drug. First the phenomena of tenuous vapours, then the strength requisite to induce complete insensibility without

interference with the essential vital processes, and, lastly, the happenings, including death, which arose when the strength of the vapour inhaled was gradually or suddenly increased to greater strength. He wrote : " The great point to be observed in causing insensibility by any narcotic vapour is to present to the patient such a mixture of vapour and air as will produce its effects gradually and enable the medical man to stop at the right moment. Insensibility is not caused so much by giving a dose as by performing a process." He insisted that the vapour tension in the mixture must vary as the temperature rises, so that what would produce a safely respirable mixture at one temperature would give a dangerously high percentage at another.

The experiments convinced Snow that definite quantities of chloroform vaporised in air did in all cases produce the phenomena which he grouped as the five *degrees* of narcotism. He insisted that it is more scientific to speak of " degrees " rather than of " stages," since the phenomena of recovery from chloroform narcosis are similar to those of induction, and so to refer to a stage of excitement, for example, is to open the door to misconception since excitement reveals itself in the second degree of narcotism, and again during recovery. The conclusions to which he arrived are that a 2 per cent. vapour of chloroform in air produces unconsciousness and a condition of true surgical anæsthesia. Further, that when this strength of vapour is exceeded the respiration becomes embarrassed, and if the inhalation is continued the breathing ultimately ceases. In the case of the lower animals removal from the atmosphere of chloroform will lead to recovery when the vapour breathed has been not greatly above 2 per cent., but if the percentage is above 4 or 5 per cent., and is breathed continuously, death will ensue.

With reference to the lethal dose, he writes : " I have not yet been able to determine satisfactorily the exact proportion of chloroform which requires to be absorbed to arrest the respiration of animals of warm blood. I believe there is a definite proportion which has this effect, but there are two reasons why it is not so easy to ascertain it as to ascertain the proportion which causes minor degrees of narcotism. In the first place, the breathing often becomes very feeble before it ceases, so

that the animal inhales and absorbs but little chloroform, and remains on the brink of dying for some time. In the next place, the temperature of the body falls in a deep state of narcotism, especially in small animals; and as the temperature falls the amount of chloroform which the blood can dissolve from any given mixture of air and vapour increases."* From this and other passages it would appear that Snow clearly grasped the fact, now well established, that, so far as respiration is concerned chloroform acts, firstly, as a result of the strength of the vapour inhaled, and, secondly, as the result of the cumulative effect of the chloroform which becomes stored in the tissues of the animal body. It does not appear that Snow or the physiologists of his day appreciated that chloroform is not only a narcotic but is also a protoplasm poison.

Two important points must be noted at this stage of our study of Snow's teaching; the one is that he is dealing for the nonce solely with the effects of the drug upon the respiration, while any interference with the circulation and other vital processes are dealt with only as the result of respiratory embarrassment or failure. The other point is that at the time of his experiments an interrupted rather than a continuous system of inhalation was practised. The patient was made anæsthetic and then the inhalation was withheld until the administrator judged that the narcosis was becoming too shallow for the needs of the operator, when a renewal of the inhalation was allowed. The types of operations then in vogue permitted such a method; there were practically no deep dissections and no abdominal surgery, so that a surgeon would complete his labours in a much shorter time than obtains to-day.

Snow and others attempted to estimate the total quantity of blood in the circulation, and aimed at supplying so much chloroform as would produce various degrees of partial saturation. He calculates that certain percentages of vapour in air would necessarily cause a definite degree of saturation, and this would cause the definite phenomena of a progressive narcotism to emerge. In fact, he pioneered one of the lines

* "On Chloroform and other Anæsthetics," p. 69, *et passim*.

of the work of the Special Chloroform Committee of the British Medical Association published in 1911, and it is remarkable that with the scanty physiological knowledge existent in his day and the complete absence of accurate apparatus, that his results tally closely with those obtained by those engaged in the later research.

To return. Snow ultimately came to the conclusion, so far as respiration is concerned, that double the strength of vapour which induced anæsthesia would, if continuously inhaled cause death. Thus he taught that 2 per cent. led to anæsthesia; 4 per cent. was the lethal dose. As we shall see in the sequel, Snow nominally employed a 4 per cent. and even 5 per cent. mixture, and met with few fatalities. How can these apparent contradictions be reconciled? The discrepancy is more apparent than real, for Snow opposed any method of giving chloroform which was not sufficiently under the control of the administrator to allow him to restrict the strength of the vapour to his estimate of the requirements of the patient. To do this effectually he designed an inhaler which, although graded to supply a percentage up to 5 per cent., yet had valves under control of the anæsthetist which permitted a gradually increasing strength of vapour. The possible 4 per cent. or 5 per cent. seems seldom, if ever, to have been reached, at least wittingly. Further, as mentioned above, at no time was the use of a high percentage persistently adopted, nor was it used at the commencement of the inhalation.

A further result of his investigations brought Snow into direct antagonism with Simpson and those who followed what grew to be called "the Scotch" method of chloroformisation. He wrote calmly but vigorously anent the dangers of "unstinted chloroform," which, even in the hands of experienced surgeons such as those of Simpson himself were, Snow averred, fraught with danger. It would certainly appear that so convinced of its safety were the early advocates of the use of chloroform that their methods were crude if not casual. Snow quotes Professor Miller, who, in his "Surgical Experiences of Chloroform," describes the plans adopted in the Royal Infirmary of Edinburgh. "Anything that will admit of chloroform in vapour being brought fully in contact with the mouth and nostrils: a handkerchief, a

towel, a piece of lint, a worsted glove, a nightcap, a sponge," was used; the glove or nightcap being especially in vogue during cold weather. Professor Miller adds: "The object is to produce insensibility as completely and as soon as we can . . . whether it is done with fifty drops or five hundred is unimportant."

Snow's inhaler was a distinct advance. In principle it consisted of a metal inhaler warmed with hot water, the chloroform was not "spilt" as Professor Miller advised, but dropped in measured quantity upon coils of bibulous paper. The arrangement of these formed an important part of Snow's technique. The vapour was allowed to pass through a long mohair tube to Sibson's valved facepiece, which last covered the mouth and nostrils and was guarded by inspiratory and expiratory valves. The inhaler was supposed to supply a 4 per cent. or even a 5 per cent. vapour, and this was diluted at the discretion of the administrator by opening or closing the inspiration valve. It is clear that so large a dead space and valve permitting the free entrance of air would materially lower the initial strength of the vapour. A low percentage strength was used at first, and this was gradually increased as time went on until anæsthesia being attained the inhaler was removed and reapplied as the exigencies of the case required. That this plan, although a great advance upon the crude methods advocated by professor Miller, fell short of ideals is shown by the fact that several deaths occurred during its use, and even in the practice of so skilled and philosophic an administrator as Snow.

Experimenting upon himself, Snow filled bags with known percentages of vapour, and arrived at results identical with those obtained in his research experiments. He admits such a procedure was the safest, but contends that some risk falling short of perfection might be allowed in order to simplify the procedure.

No doubt Clover's chloroform bag owed its origin to Snow's suggestion, and replaced in the former's practice the dangerous plan he initiated of applying to the patient's face lint wetted with the reagent and covering this with a towel. It is interesting to note that Clover met with no

deaths while using the lint and towel system, although others were less fortunate.

Up to this point we have dealt with Snow's views of chloroform so far as respiration is concerned, but that astute observer soon found that another and greater danger arose when the strength of the vapour inhaled was greater than those which induced death gradually by paralyzing respiration. He reasoned that chloroform given continuously in vapours of 4 per cent. or over produced effects upon the central nervous system, and did so when the blood had absorbed its optimum of safe saturation, but if a strong vapour was suddenly presented to the patient it passed, so Snow taught, through the coronary circulation to the heart and caused cessation of the general circulation even before the anæsthetising effect upon the brain had been produced. The cessation of breathing was immediate, the poisoning of the heart was fatal. It is of interest to note that in some of the animals killed by high percentages of chloroform the autopsy showed inchoate twitching of isolated bundles of muscular fibres in the myocardium, a phenomenon which has been studied by Professor MacWilliam and called by him *delirium cordis*. Snow also appears to have recognized that it was not the mass amount of chloroform which passed through the heart but the strength of the vapour which caused death.

Snow made some important experiments upon the analgesic effects of chloroform, confirming his views from the stores of his wide clinical experience. He differentiates sharply the central nervous- or brain-induced anæsthesia from the lessening or loss of common sensibility. This last, he points out, "does not keep pace with the degree of narcotism of the brain as shown by the presence or absence of consciousness and volition." This must depend upon the chloroform acting upon the peripheral distribution of the nerves. The fact has of late years been, in a measure, lost sight of that general anæsthetics do as a matter of fact not only annul perception of pain but protect the brain from the hypothetical "bombardment" of the nervous tissue by noxious centre seeking stimuli. He also made the pertinent observation that in order to obtain peripheral analgesia an evenly distributed partial blood saturation by the anæsthetic is requisite. Thus a slowly but

evenly induced narcosis is essential to this end. Waller's classical work on the effects of anæsthetics upon detached nerves has now bridged the gap in our knowledge, and has taught us that the analgesic effect arises from, first, a retardation and then an annulling of the conductivity of the nerve cylinders. Further, Snow points out that both the brain anæsthesia and the loss of common sensation vary in their time of onset in different types of individuals. In stout persons the time is short, in intellectuals it is the longest, while in heavy drinkers, although the tardily arrived at brain anæsthesia may be profound yet the lower reflexes would appear to persist, as such persons move their limbs and execute what appear to be protective reflexes even in deep narcosis, in much the same manner as in the case of the brainless frog. Snow does not deal with reflexes, but he arrives at conclusions given above; nor did he know of the avidity which lipoids possess for chloroform and ether.

Two of the most interesting and valuable sections in his book are those dealing respectively (1) with fatalities, real or assumed, and (2) with the symptoms of such fatalities. He dismisses the notion that there is an idiosyncrasy predisposing to chloroform accidents. He believes that fear, incomplete anæsthesia, that is, too light a grade of narcosis, are dangerous. The sudden deaths he imputes to high percentages stopping the heart and causing syncope. Wakley and the Emulation Society of Paris attempted to prove that the respiration always caused death, and the heart always failed subsequently; but Snow shrewdly points out that their experiments were faulty, as no attempt was made to paralyse the heart by overdosage by high percentages. This error was repeated in the more recent experiments of the Hyderabad Commission, a fact which the present writer pointed out at the time of the publication of the Report. Further, Snow discusses with great care and acumen the effect of chloroform when given to persons suffering from various diseases. His well-known dictum may be quoted, as it remains a guide to anæsthetists to-day. "If," he writes, "a patient's condition is such that he can be subjected to operative procedure, he can certainly be anæsthetised without undue risk." In this connexion we may recall his experience of hysterics and epileptics; the former he

found usually had a fit in the second, the latter in the third degree of narcosis. As regards epileptics, the present writer's experience goes to show that in the case of Jacksonian epilepsy the fit, which practically always occurs during induction, generally developes in the second degree, especially if the excitement is marked. Snow suggests that the administration of chloroform to malingerers who behave like an epileptic proves a useful test.

There is one important point in which the practice advocated and adopted by Snow differs from the view commonly held by modern-day anæsthetists. He could see no danger in the sitting posture, and he quotes over nine hundred cases in which he so placed his patients. But this was before the days of the radical operation of tonsillectomy and submucous resections. Whether Snow, had he our knowledge of the capillary circulation, and Leonard Hill's work on the "abdominal pool," would have adhered to the views he enunciates on this point in his book is, we think, at least doubtful.

It would be tedious, in a paper of this kind, to labour the matter further, but it will probably explain many of the discrepancies of Snow's dicta and the teaching of to-day if we quote his directions about administration, since they show in vivid contrast the method he adopted and the methods which the modern surgeon requires to be pursued by the modern anæsthetist. Snow writes: "The first application of chloroform often suffices for an operation, if it is of short duration, without repeating the inhalation. In a few cases the patient remains insensible to the knife for three minutes after the inhalation is left off, but this is an exception; and one cannot at all events make sure of this prolonged effect of chloroform, without producing a deeper state of narcotism than is desirable. More usually, if the operation lasts more than a minute or two it is necessary to repeat the inhalation; it is, indeed, generally desirable to let the patient have a few inspirations of air charged with chloroform vapour every half minute or so whilst the operation continues in order to keep up the insensibility." "In the greater number of operations, however, it is better to wait till there is some sign of sensibility, such as a slight cry or tendency to flinch, before the inhalation

is resumed; and then a few inspirations of well-diluted vapour made the patient quiet again."

In spite of the obvious difference between the exigencies of surgery in Snow's time and our own, the writer is convinced that Snow's work is still worth careful study and consideration. His analysis of fatal cases, his experiments undertaken to explain the mechanism of death under chloroform are admirable in their clarity and accuracy of reasoning. The fear of chloroform so prevalent to-day is largely due to our ignorance of its action and our neglect of the more accurate methods of employing it, and in this sense is deplorable. To study Snow's work and follow it by studying the more recent experimental research would, the writer believes, prove most helpful to those who, not being experts, have relegated chloroform to the limbo of bogeydom and so lost the aid of a most valuable asset to their anæsthetic armamentarium.

In keeping with the plans for the readjustment of the medical profession in America into regional groupings, it is the intention of the Reorganization Meeting of the Associated Anæsthetists of the United States and Canada to build up a strong parent organization, and thus realign the Regional Societies.

The Third Annual Congress will be held at Chicago, June 9-14, during the Medical Association Week, the Anæsthesia Session being a part of the Section of Miscellaneous Topics.

The five Regional Societies—Canadian, Eastern, Southern, Mid-Western and Pacific Coast—will be represented by delegates who will be empowered to form plans for the new organization which is to be known as the Associated Anæsthetists, and which is to be governed by a House of Delegates to consist of two or more delegates from each regional society, as well as officers and executive staff.

The Associated Anæsthetists will undertake the standardization of hospital anæsthesia service, will encourage graduate and post-graduate instruction, and, if thought advisable, develop a College of Anæsthesia.

If these plans are agreed to each anæsthetist member will be called upon to contribute a total of about four pounds annually in subscriptions, viz., to the Associated Anæsthetists, to his Regional Society, and to the Research Society.

If this arrangement is carried out it will place the specialty of anæsthesia in America on a solid basis. It will mean that on all matters of importance united action can be taken by an executive able and authorized to speak for the united membership of the United States and Canada.

MODERN DEVELOPMENTS IN ANÆSTHESIA.

By S. R. Wilson, M.B., B.S., M.Sc., F.R.C.S.E.

(Post Graduate Lecture, Manchester Royal Infirmary, Dec. 14, 1923.)

IT has been said by Bernard Shaw "that anæsthesia spares us nothing but the actual cut"; but whilst this may have been true in the past it no longer applies to the up-to-date anæsthetist, who is not simply concerned with the production of unconsciousness but with the comfort, safety and ultimate recovery of the patient, in addition to the facilitation of the special surgical procedure. Such a standard can only be attained by careful preliminary preparation, by thorough examination of the patient beforehand, and by a scientific knowledge of the immediate and remote effects of the anæsthetics concerned, both in health and disease.

In connexion with the investigation of the patient's condition it is my hope that we shall in future gain more and more help from co-operation with the physician than hitherto. Unfortunately, many medical opinions have not been too helpful in the past, and the reason of this is not far to seek. Too often he contents himself with saying, "whether an anæsthetic may or may not be given," an attitude which gives us no real information and frequently ties our hands considerably, for the determination to administer an anæsthetic and the precise procedure to be adopted is entirely outside his sphere. He should content himself with a full report of the patient's medical condition and leave the rest to the anæsthetist, who is only too pleased to have the benefit and assistance of his skilled medical examination. The influence of modern scientific work on anæsthetic procedure may be conveniently discussed under the following headings: (1) The preparation of the patient; (2) anæsthetic prognosis; (3) the period of induction; (4) the period of maintenance; (5) the period of recovery; (6) post-anæsthetic complications.

The Preparation of the Patient.

This branch of the subject is of equal interest to the surgeon, anæsthetist and practitioner, and one frequently gets inquiries as to the preparation one prefers.

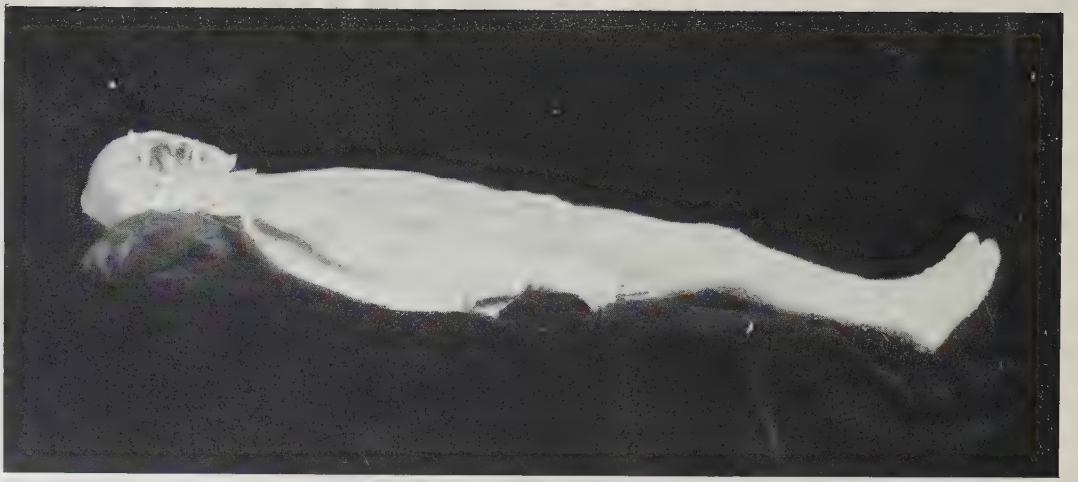
The chief modern development in this respect have been directed towards the reduction of starvation and excessive purgation, for these procedures tend to produce mental distress and exhaustion of the patient. Further, they actually predispose to acidosis, shock, and septic infection.

Perhaps the simplest way of dealing with this aspect of the subject will be to define one's routine procedure in an adult about to undergo a surgical operation of average severity. It is desirable that the patient should be admitted into the home or hospital at least two nights before the operation. From the very first strict attention is given to the antiseptic treatment of the mouth. The patient is instructed to rinse the mouth before and after food with sodium phenate or Listerine, and to thoroughly cleanse the teeth, whether natural or artificial. In operations about the mouth the services of a dentist may have to be requisitioned. This procedure lessens the liability of pulmonary and parotid infection, minimizes the risks of alimentary intoxications, and gives the patient something to do. As regards aperients, the time-honoured ones are still the favourites, viz., castor oil (up to 1 oz.) and compound liquorice powder (up to 2 drachms). The time of administration is, however, a point of considerable importance, and the most favourable period is about 2—3 a.m. of the night but one before operation. This ensures minimum disturbance of the patient's rest, for at worst it splits the patient's rest into two four-hourly periods, and the effect of the drug takes place in the daytime, and is not so upsetting as at night. If the aperient acts satisfactorily (say three times) no further preparation is necessary in this respect, but if there is any doubt a simple enema is given at 6 p.m. of the evening before operation. This should be administered with a tube and funnel, and not with a Higginson's syringe. In some cases enemas have a disturbing effect on the patient's condition, and may cause considerable shock. On occasion one has had to postpone operations temporarily on this account, and one is inclined to believe that it is forcible distension of the colon that is

responsible for the effect. With the preparation under discussion enema rashes seem to have practically disappeared. As regards diet, all foods given to the patient are sterilized. This does not involve any complex or elaborate preparation, but a selection of those foods which in virtue of their natural modes of cooking are rendered sterile, viz., lightly-boiled eggs, soups, steamed fish, toast and milk puddings. Some prefer to exclude from the diet all albumins of animal origin and maintain that this avoids post-anæsthetic vomiting and lessens the work thrown on the liver, but with the diet recommended after-vomiting is very rare. The meals are given at the usual time, the last meal on the day before operation being at 7 p.m. and consisting of soup and toast. Some anæsthetists advocate milk, but personally I prefer soup, for in nervous patients I have known clots to be vomited 24 hours after milk has been taken. The final meal is given four hours before the time of operation, but this period is reduced to 2—3 hours in the case of children. This last meal also consists of soup and toast. In the case of children, glucose is administered in the form of barley sugar, raisin tea or sweetened liquids practically up to the time of operation. Some advocate glucose in adults, but this is a point of lesser importance, and may as a rule be omitted. The patient is encouraged to drink as much fluid as possible, and a jug of water is left at the bedside. In rectal cases an additional procedure is advisable and will avoid those distressing experiences which one so often saw in the past when surgeons operated on this part, an incident which caused unmerited blame to fall upon the nursing staff, for the excessive purgation of those days frequently led to the production of diarrhœa. In this class of case, one hour after the administration of the evening enema, five minims of Tinct. Opii in one drachm of water are given, and this is repeated four-hourly until three doses have been administered. The opium produces a state of quiescence in the bowels, which have been fairly well cleared by the earlier procedure, and interruption of the surgeon's work and contamination of the field of operation are avoided. Finally, one would like to draw attention to the patient's clothing as regards preparation for operation. The lowering of body temperature is undoubtedly an important factor in the

production of surgical shock, and for some time past surgeons have been in the habit of wrapping up the patient's limbs in cotton wool as a preliminary to severe operations. The cause of this lowering of temperature is partly the disturbance of the thermogenic centres by the anæsthetic, but the most important factor is the evaporation of sweat. It is not the secretion but the subsequent evaporation of the sweat which matters most for the latent heat of evaporation required is largely abstracted from the body, chilling the latter. This is easily noticeable about the head and neck in severe cases, and in the past one has been in the habit of packing round the head and neck with gamgee tissue. This method is, however, clumsy, extravagant in wool, and leaves the patient unprovided for after returning to bed, where the same factors still hold good. I would remind you that the greatest accumulations of sweat glands are on the palms of the hands, the soles of the feet and about the face; parts largely ignored in former preparations. With these objects in view, I have devised an operation suit, and the making of the same has been carried out by the Nursing Staff of the Elmfield Nursing Home, Manchester. The patient is clothed in a woollen vest and pyjamas. The head and neck are enclosed in a flannel helmet, which is adjustable, and can cover up all parts save those actually covered by the anæsthetic mask. A slit in the helmet will enable one to observe the condition of the ear and feel the pulse. The upper extremities from wrist to shoulder are enclosed in special flannel sleeves, fastened with tapes, and thick woollen gloves enclose the hands and extend over the flannel sleeves to the elbow. Woollen stockings are worn over the pyjamas and extend almost to the groins (illustration). The suit is especially serviceable in abdominal operations. It has been in use for some time with most gratifying results, the patient's skin being devoid of any suspicion of clamminess and pallor which were formerly often observed in varying degrees. The suit is retained when the patient returns to bed and prevents loss of heat from the body in the recovery stage.

Before leaving the question of preparation of the patient one must refer to the problem of the preliminary administration of alkaloidal drugs.



Operation Suit. (Wilson.)

Preliminary Medication.

Of late years the general tendency has been to rely on atropine alone as a routine procedure, except in the case of nitrous oxide and oxygen administrations. The advantages of atropine are indisputable. It is a respiratory stimulant, and in virtue of its power of inhibiting the buccal and bronchial secretions lessens after-sickness, minimises the risks of pulmonary complications and facilitates a free air-way, for, in addition to the diminished secretion, it produces bronchial relaxation. By paralyzing the vague nerve-endings in the heart it lessens the danger of reflex syncope from too strong a vapour or from surgical manipulation. It diminishes shock, and, by lessening the secretion of sweat, removes an important cause of lowering of body temperature during surgical operations. The diminution of secretion which it produces renders it of special value in operations on the upper air-passages, and Mr. Musgrave Woodman informs me that he gives two preliminary injections of the drug for this purpose. The chief objection to atropine is the dryness of the mouth and thirst which results, but this can be minimized if the injection be delayed until 20—30 minutes before administration. The patient may be allowed to rinse out the mouth with water beforehand provided none is swallowed. After-thirst is of little consequence, for most surgeons allow the patients to drink freely on recovery from the anæsthetic. Levy states that atropine carries with it an increased risk of ventricular fibrillation, but I do not think that clinical experience affords evidence of this.

Further experiments on animals are desirable before making a definite statement on this question.

I abandoned morphine as a routine procedure about 15 years ago, partly on account of the respiratory depression which it causes. The induction period, though quiet, tends to be delayed on account of the respiratory exchange being diminished about 50 per cent. unless a closed system of administration be employed. Cyanosis is very prone to occur, and muscular relaxation is not usually so complete. Oxygen ought certainly to be at hand if morphine is used. Fluid in the throat is not so easily spontaneously dislodged, and the delay in the recovery period in getting rid of secretions and

dissolved anæsthetic leads to prolongation of sickness and increased risk of pulmonary infection. A further objection to morphine is that it masks the pupillary reactions, whereas atropine in ordinary doses does not. At the same time there are certain cases in which the preliminary administration of morphine is of extreme value.

(1) Before administering nitrous oxide for small surgical operations, such as whitlows and cellulitis. In these cases it abolishes the reflex movements which are prone to occur on incision into acutely inflamed parts, and saves the patient the immediate severe after-pain.

(2) When nitrous oxide and oxygen are used for major surgical operations. For this purpose Boyle recommends Hyoscine Compound, A. or B. (Burroughs-Welcome) half an hour before administration, except in the case of children.

(3) In cases where one desires to reduce the amount of anæsthetic used, as in diabetes and acidosis.

(4) Whenever excessive activity of the sympathetic system is present. This occurs in exophthalmic goitre and in patients of the sympathetico-tonic type, who manifest considerable psychic shock.

The action of morphine in paralyzing sympathetic ganglia is of the utmost importance in these conditions, and has not, in my opinion, been sufficiently realized. To obtain the full benefit of the drug it should, however, be given in small doses over a fairly long period. In exophthalmic goitre I frequently give three or four doses of $\frac{1}{8}$– $\frac{1}{6}$ grain at four-hourly intervals, the last being given half an hour before operation and combined with atropine.

In cases where limitation of anæsthetic is required the development of synergistic anæsthesia is likely to prove of great value, and I have resorted to it with satisfaction in bad cases of hyper-thyroidism. For interesting applications of this method in childbirth one must refer to papers by Gwathmey and others in the first two issues of the *British Journal of Anæsthesia.*

Anæsthetic Prognosis.

Those engaged in surgical practice are only too familiar

with a certain adage, which is not infrequently repeated in lay circles with a certain amount of derision, "the operation was successful, but the patient died." The statement is, to say the least unfortunate, and the underlying sarcasm deserved, for the true measure of surgical success lies in the cure, or at any rate in the relief of the patient. Whilst, in desperate cases, excessive risks are necessary, in others a careful estimate of the operative risk should be made. Mere collections of post-operative mortality figures give no accurate estimate of the individual risk incurred. In such an investigation the anæsthetist is intimately concerned for the selection of the most suitable form of anæsthesia, the estimation of the amount of surgical manipulation which the patient can stand and ultimately survive, and the avoidance of deleterious or dangerous post-anæsthetic effects are his special duty. It is in this direction that the greatest advances in general anæsthesia are to be made.

Whilst in no way decrying the value of an ordinary clinical examination of the patient, I wish to draw attention more particularly to those observations which are of special value to the anæsthetist in this regard, concerning which we rarely receive information from the physician.

1. *The condition of the blood.* The existence of anæmia is of particular import, for such patients will not stand much loss of blood or profound lowering of blood-pressure. Further, a fatty condition of the heart muscle probably co-exists. Whilst as a rule a general inspection will suffice, in pronounced cases more accurate observations are desirable, and either a hæmoglobinometer or Tallquist's hæmoglobin scale should be resorted to. If the hæmoglobin percentage is 60 per cent. or less chloroform is extremely dangerous and should be avoided. A closed method of administration (gas and oxygen with ether) is to be preferred, for the retained carbon dioxide is of great value in maintaining the blood pressure.

Chloroform also increases the fragility of the red blood corpuscles, and should be excluded where this condition already exists, as in acholuric jaundice.

A knowledge of the blood coagulation time is also of great value at times, and in my own experience during the past few months relatives have reported that the patient is a hæmophilic

after the administration had commenced and whilst the surgeon was preparing his hands. One was able in a few minutes to recommend the surgeon to proceed and incidentally remove future anxiety from the relatives' minds. Whilst ten methods of determining coagulation time are available, the most convenient ones in surgical work are the "glass plate method," Dale and Laidlaw's shot coagulator, and Gibb's platinum loop. The necessary appliances occupy very little space in one's bag, and even if absent a rough estimate may be made with the polished glass of a hand-mirror and the blunt end of a needle. If a thread of fibrin can be drawn up out of a drop of blood on the glass with the needle within ten minutes one may proceed without anxiety.

2. *The cardio-vascular system.* The estimation of blood pressure affords the most valuable information in relation to operative prognosis. It enables one to determine the condition of the cardiac muscle and indicates the capacity of the patient to withstand hæmorrhage, shock and surgical manipulation. It also intimately modifies the choice of the anæsthetic.

Both systolic and diastolic pressures should be determined, the difference between the two giving the pulse pressure. Moot's rule is most valuable in this respect:

$$\frac{\text{Pulse pressure}}{\text{Diastolic pressure}} \times 100.$$

If the resulting figure is between 25—75 per cent. the case is favourable. If outside either of these figures the case is unfavourable.

McKesson has also made an observation of the utmost importance as regards the relationship of blood pressure to operative mortality. Although it refers to the period of maintenance of anæsthesia it is convenient to mention it here. He states "That after half an hour of sustained low blood pressure and rapid pulse almost every patient succumbs, either shortly or within three days of surgical shock or cardiac exhaustion." It is the anæsthetist's duty to observe these points and to draw the surgeon's attention to the necessity of acceleration of the operation. If the operation is completed within the half hour recovery usually occurs. Another simple test of great value is the "breath-holding test." The patient is instructed to take three deep breaths and the last one is held.

If the breath cannot be held 40 seconds further investigation of the cardio-vascular system is necessary. At the same time it should be borne in mind that a similar state occurs in acidosis. Further tests of cardiac efficiency have been devised from a study of the effects of exercise on the circulatory and respiratory systems.

Cashman's test. Normal exercise raises both systolic and diastolic pressure, but the former is increased to a greater extent, with the result that the pulse pressure is increased. A fall of pulse pressure implies poor resistance in the circulatory system.

Goodall and Lambert's test. The pulse, systolic blood pressure and respirations are taken before and after standard exercises. According to results observed they classify the responses into four groups:—

Group 1. Good. All the reactions are increased by exercise, but all return to normal in three minutes.

Group 2. Fair. The return to normal is not so quick, but occurs on normal lines.

Group 3. Bad. The blood pressure is not raised, but pulse and respiration are increased.

Group 4. Very bad. The blood pressure falls, but pulse and respiration are increased.

Whilst these exercise tests are of great value, the presence of serious illness in the patient may render the standard exercises undesirable. Under such conditions information of value may possibly be obtained by the use of the manometer test. My attention was originally drawn to this by one of my colleagues in the Physiology Department, Dr. McSwiney. He and Hambly used a modification of Flack's test to study the influence of the manometer test in relation to muscular exercise. The pulse-rate is taken for one minute; a column of mercury is then raised by expiration to a height of 40 mm., and held there for twenty seconds. The pulse-rate is then taken for another minute. After muscular work there is on an average a fall of 10 per cent. in the pulse-rate. I have tried to adapt the test to surgical work without any preliminary exercise. The necessary apparatus is easily improvised from a mouthpiece of glass tubing connected with rubber tubing to the aneroid of a sphygmomanometer. A marked fall in pulse-

rate or inability to sustain the test is suggestive of cardiac insufficiency. In feeble women or in debilitated subjects a height of 20—30 mm. is sufficient. More extensive observations are desirable before one can estimate its precise value. In cases of actual cardiac disease and in exophthalmic goitre electrocardiograph and polygraph tracings are of value.

Cases of cardiac disease—even auricular fibrillation—usually do very well if struggling be avoided and an appropriate anæsthetic be selected, viz., open ether and oxygen. A preliminary course of treatment with digitalis is of the utmost value.

3. Metabolic tests. The basal metabolic rate is an observation of some value in cases of hyperthyroidism. It is determined by the Sanborn-Benedict apparatus. If the oxygen consumption is over 150 (100 being taken as normal) the condition is not very favourable. Of late Crile has expressed some doubt as to the value of this observation, but I am inclined to think that it affords evidence, at any rate, of the effectiveness or otherwise of the preliminary medical treatment adopted. In the Mayo Clinic iodine in the form of Lugol solution is administered in 10 m. doses daily as a preliminary, and is said to reduce the palpitation, tremors and nervousness, in addition to lowering basal metabolism. Lugol solution is the Liquor Iodi Co. of the U.S.A. Pharmacopœia, and consists of iodine 5 parts, iodide of potash 10 parts, and water to 100 parts.

Under the heading of metabolic tests one may conveniently turn to the question of hepatic, renal and pancreatic insufficiency. The condition of these organs is of great importance to the anæsthetist, as it markedly influences the choice of the anæsthetic, and likewise the depth and duration of the anæsthesia. It would appear that the action of the various general anæsthetics on these organs is proportional to their lipoid solvent power. Chloroform is the most damaging in this respect, whilst nitrous oxide and oxygen is the least toxic. The anæsthetic must be reduced to a minimum and anoxæmia avoided.

The determination of hepatic insufficiency presents considerable difficulties partly on account of the numerous functions which the liver subserves, partly on account of the

interdependence on other organs, particularly the kidneys. A personal experience will emphasize the importance of this close association of the two organs. Some months ago I was asked to administer an anæsthetic in a case of suspected gall-stones. Examination of the urine revealed a large quantity of albumin. A physician was called in and diagnosed organic disease of the kidney. Owing to persistent pain an exploratory operation was performed and gall-stones removed. After 48 hours the albumin entirely disappeared. In this case the albuminuria was a sequel of an hepatic toxæmia. Subsequent observation has shown that such an association is not uncommon. Whilst considerable attention has been given to this subject of late, the precise value of the various tests are still somewhat uncertain. The best tests up to now would seem to be: the ratio of urea nitrogen to total nitrogen, the camphor test, Van der Bergh's test, the lævulose test, and the lipase test. Useful information might be obtained by performing these tests before and after a general anæsthetic.

The estimation of the blood urea throws light both on the hepatic and renal condition. Normally its amount is 20—40 mmg. per 100 cc. If it exceeds 90—100 mmg. the prognosis becomes unfavourable.

The urea concentration test is of value if taken into consideration with other factors, especially the blood urea. The relationship desired may be expressed thus:—

$$\frac{\text{Mmgs. of urea per 100 cc. urine.}}{\text{Mmgs. of urea per 100 cc. blood.}}$$

If the resulting figure is between 60 and 80 the outlook is favourable.

An ordinary routine examination of the urine should always be made, the most essential tests being for albumin, sugar, acetone and di-acetic acid. If albumin is present further investigation as to its cause must be made. When sugar is found the case should be placed in the hands of a physician for investigation of the nature of the glycosuria. If the condition is one of true diabetes operation should be postponed until suitable dietetic and insulin treatment have been established. The importance of acetone and di-acetic acid and other special tests bearing on this subject will be dealt with when considering post-anæsthetic toxæmias.

SOME RESULTS OF OPERATIONS UPON THE CIRCULATION: THEIR SIGNIFICANCE AND TREATMENT.*

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THE more recent extension of laboratory examinations and more thorough physical examinations made before operations is a great step toward the individualization of treatment. It is a movement in the right direction which needs to be still further developed in the best interests of surgery and the patient. We cannot know too much of the patient's physical condition. It furnishes the necessary basis for interpreting the reactions observed during and after operations, and renders surgical intervention safer and more definite.

The surgical team is rapidly coming to be made up of a group of co-operating specialists whose members are prepared to apply the discoveries of the various medical sciences to the patient at operation. The surgeon in particular needs to encourage and develop his associates so that they may better perform important functions which he is unable to carry out during the operation. The only way to develop the anæsthetist into an internist with a surgical "slant" is to increase his responsibilities and to demand more definite answers to that common question: "What is the patient's condition?"

Laboratory work and physical examinations lose much of their force if similar and accurate observations are not followed through the operations. In the average clinic this is not being done as well as it might. Not infrequently circulatory reactions begin on the table which, if neglected when they might be corrected, lead to the destruction of the patient and to the discredit of surgery. The blood pressure and pulse furnish some of the desired information. Neuhof,[3] in his

* Read before a joint session of the Chicago Medical Society and the Chicago Society of Anæsthetists, March 12th, 1924.

new book on "The Heart," puts it aptly when he says: "The introduction and use of the sphygmomanometer have shown that the estimation of the blood pressure by radial palpation alone is erroneous and untrustworthy."

The circulation is a delicately balanced mechanism which reflects the immediate condition of the patient in a most exact manner. A continued study of its reactions soon convinces the observer of the truth of this statement. The variety of responses is large, and it requires experience and study to interpret them, but every anæsthetist should master what seems to me to be one of his most important duties.

To make the work practical and of immediate as well as of educational value, a graphic record of the pulse-rate, the systolic and diastolic blood pressures, the respiration and notes regarding pertinent factors influencing the patient, should be made during the operation at frequent intervals. The official anæsthetic chart* of the National Anæsthesia Research Society embodies the minimum requirements.

Fortunately, these observations and records may be made by the anæsthetist without much inconvenience. With this information the anæsthetist will learn more of the direct effects of his technique and what anæsthetics are best. The surgeon also will learn by a review of these records that certain methods of operating under certain conditions are good or bad. In the end, both are benefited with the patient.

Equipment.

The auscultatory method of taking blood pressures is preferred as being more accurate and more convenient in surgical work. Mercurial instruments may be used, but the aneroid type, either large or small, is more practical in the operating room. The cuff is applied to either arm, preferably the right. It should be smoothly wrapped about the arm and the flaps secured with a safety pin. It is left in place throughout the operation. The stethescope should be a Bowles or similar flat-belled diaphragm type, applied just below the cuff and above the elbow, squarely over the artery.

* Arrangements are now being made to place this chart on sale in Great Britain.—(Editor.)

It is held in this position by means of an ordinary elastic web, three-fourths of an inch wide, with a suitable buckle for adjusting it. Inelastic material, such as leather, etc., is an unsatisfactory substitute for elastic, as it does not maintain the position of the stethescope bell with gentle pressure. A rubber tube about two feet long, connecting the bell with the ear-pieces, completes the equipment.

A determination of the pulse-rate, blood pressures and respiratory rate should be made just before beginning narcosis. This reading gives much information regarding the effects of fear, the effects of pre-anæsthetic narcotics in controlling this factor as well as serving as a criterion for comparison with subsequent readings.

After narcosis has been satisfactorily established, but before the surgeon begins, another set of readings gives the immediate effects of the anæsthetic and serves as the operative normal which it is desired to maintain or to improve if incompatible with the well-being of the patient.

Circulatory Depression.

The outstanding factors in an operation are: (1) the condition of the patient, (2) the trauma of surgery, (3) the loss of blood and other fluids, (4) the protective or destructive effects of anæsthesia. One or all may be factors of depression.

While it may be assumed in the normal case that the circulation is at its optimum before an operation, and that practically *any* change in pulse and blood pressures indicates some measure of depression, there are some abnormal conditions which are actually improved during narcosis. The latter is, however, the exception, and is usually the result of well-directed attention to details in the operative and anæsthetic procedures, and not accidental.

In previous papers [1] I have classified circulatory depression into three degrees, roughly corresponding with the clinical results obtained:—

The First Degree comprises an increase of not more than 15 per cent. in the pulse-rate without an increase of blood pressures, or a 10 per cent. decrease in blood pressures without an increase in pulse-rate.

The Second Degree comprises an increase in pulse-rate of about 25 per cent. associated with a decrease in blood pressures of from 10 to 25 per cent., or equivalent combinations.

The Third Degree comprises a pulse-rate of 100 and progressively increasing; associated with a systolic of 80 mm. or less, a diastolic of 60 mm. or less and a pulse pressure of 20 mm. or less, all progressively falling.

Third degree depression is usually fatal if allowed to continue during an operation for a period longer than twenty to thirty minutes without successful treatment. The patient may live for minutes or as much as seventy-two hours in this condition of shock, depending upon the vital resistance and previous condition of the heart muscle. When death occurs, it is one of cardiac exhaustion, complicated by incomplete oxygenation and nutrition.

It is evident that both the blood pressure and the pulse-rate are essential in evaluating the circulatory situation, and that shock, which is represented by the third degree, is characterized by low pressures and tachycardia. Low pressures are more compatible with life than tachycardia, but their combination spells disaster sooner or later, unless effective treatment is applied promptly.

In checking up the prognosis of third degree depression, Miller, in 1,000 cases, found that those who were in third degree for more than 25 minutes showed a mortality rate of 69.23 per cent.[4]

Tachycardia.

The tachycardia of fear is best prevented by appropriate doses of morphine with or without hyoscin, but without atropin. Tachycardia is objectionable before, during and following operations, as it exhausts the heart, shortens its period of rest, and reduces the regeneration of the heart muscle.

During an operation, tachycardia is usually preceded by a temporary fall in blood pressures, sometimes for a considerable period before the pulse-rate increases. The increase of pulse-rate in these cases, when it does begin, is usually abrupt, due to some new manœuvre of the surgeon, a spurt from a relatively large vessel, temporary obstruction of respiration,

or some error in anæsthesia. Once the pulse-rate is elevated under these conditions it rarely returns to its old rate until after the packs are removed and the abdomen is closed. With the increased pulse-rate the blood pressures ordinarily increase, but not in their normal ratios. If the error is shortly repeated a further increase in pulse-rate may take place with little increase in blood pressure, while if the offence is too great the blood pressures actually fall while the pulse-rate climbs to the status of tachycardia. Under such conditions the heart is probably not at fault, but is making an effort to maintain an efficient circulation after some disturbance in the distribution of the blood has taken place, which lowers the blood pressures. The systolic falls out of proportion to the diastolic, often leaving a small pulse pressure. In other cases the pulse pressure is relatively increased. These are the more favourable.

Myocardial Defects.

Cardiac arrhythmias affecting the rate are readily detected in the pulse. The *functional* types often disappear during a carefully conducted narcosis. The circulation in these cases is usually good, but sometimes improves. The *organic* types either do not improve or are made worse.

Pulsus alternans, which is an arrhythmia not of rate necessarily, but of weak and strong heart contractions characterized by alternating small and large pulse pressures is not only readily detected with the sphygmomanometer, but is subject to actual measurement. Arrhythmias, particularly of this type, require close watching, because, as pointed out by Herrick, Lyons, Hawthorne and MacKenzie, they indicate "a serious impairment of the muscular organisms of the heart, which has lost the capacity to respond with maximum contraction to every stimulus—the contracting capacity is diminished."[2] It is second in frequency of the cardiac arrhythmias, and of particular importance in surgery as indicating myocardial defects.

The patient may show no arrhythmia before operation, but under the stress of surgery pulsus alternans occasionally develops, showing that the heart muscle is unable to adequately respond to the extra labour. It is encountered

more frequently in hypertension, arteriosclerosis, myocarditis and nephritis. In surgical cases, I have found it also in cholæmia, eclampsia, anæmia and uræmia—some of the cases which are regarded as dangerous risks. These cases promptly succumb to a fall in blood pressures and increased pulse-rates, amounting to what I have described as third degree depression if untreated.

If the condition is recognized before operation, digitalis is indicated, even though the pulse-rate is not rapid, and when it develops during operation some digitalis preparation should be administered intravenously. The operation should proceed with the minimum of trauma under light narcosis. Morphine in sufficient doses to produce its physiological effects is desirable, preferably before, but may also be used with good results during, the operation.

Pulsus alternans must be differentiated from sinus arrhythmia, which causes a rhythmical variation in the systolic and diastolic blood pressures, associated with corresponding changes of pulse-rates caused by respiration. And, while it is generally held that sinus arrhythmia is a physiological process, it is rendered more apparent in operations than normal owing to the greater difference in pulmonary air pressures than normal. There is little danger, however, of confusing it with pulsus alternans on account of its synchronism with the respiration.

Myocardial defects are more serious than valvular disease of the heart if compensated. The crux of the matter is, whether or not the circulatory mechanism is able to maintain a proper distribution of blood without cardiac exhaustion during the relatively short period of surgical intervention.

A study of the case at the moment will show how far we may go with surgery. If the case is border-line before beginning the operation, the test of surgery only will tell how the circulation will react.

Patients with valvular defects which are grossly complicated with myocardial weakness require most careful anæsthesia and surgery to avoid disaster. All valvular cases may be regarded with suspicion until the test of surgery shows the heart muscle to contain the essential reserve power to compensate for any ordinary disturbance of blood distribution.

Treatment of Third Degree.

We formerly lost more cases from shock than we do now, because we had about reached the conclusion that no treatment except prophylaxis, which in many cases is impossible, was really effective. I had tried all of the drugs recommended, including saline and gum solutions, with quite unsatisfactory results.

More recently I have saved most of those who would have died in third degree with sterile physiological salt solution, given intravenously, employing such a quantity, whether it be 500 cc. or 5000 cc., as is necessary *to restore the systolic pressure to within 10 per cent. of its normal reading*, and repeating it by the intravenous route at any time shock reasserts itself.

It is important that the saline be isotonic, that it be given sufficiently rapid (up to 100 cc. per minute) to build up the systolic blood pressure progressively, that it is administered at body temperature, and that it is given as soon as possible after third degree has become established.

In the average hospital too much time is lost in the preparation of this equipment. Shock drill should be more important in a hospital than fire drill. The equipment should be kept in readiness and in good condition for prompt service, as delays cause preventable loss of life.

Two errors in the treatment of third degree depression are commonly made: (1) The condition is not recognized until it is so well advanced that the vicious cycle of muscular exhaustion plus insufficient nutrition caused by rapid systoles and low blood pressures is fairly established; (2) when saline is used it is usually administered either via the rectum or subcutaneously, neither of which routes are often successful; or, if given intravenously, it is not run in fast enough to overtake the falling blood pressure, or it is given in an insufficient quantity.

It would be better if the quantity were not measured by those who fear that too much might be given, since no quantity short of enough to fairly restore the blood pressures will save the life. The slower the solution runs in the more is required to restore the blood pressure.

The diastolic is not usually increased as promptly or as

much relatively as the systolic. In fact, the diastolic commonly is increased very little until after the systolic has been up for some time showing that muscular tonus in the peripheral vessels is slow to return.

For some time after saline the pulse pressure is relatively very large. (Normally the pulse pressure is half the diastolic pressure expressed in millimetres with an allowable 10 per cent. variation above or below without indicating pathology.) Gradually the pulse pressure approaches the patient's normal, which is ordinarily due in these cases, to an increased diastolic with some fall in systolic.

I have never seen a heart dilated by giving too much saline intravenously, although I have given over 5000 cc. in two and a half hours in one case. On the other hand, I have seen several deaths in years past because too little saline was given, which I now believe were preventable.

Where the saline is used in large amounts there are occasionally some œdema of the lower eyelids. But this is gone in a few hours after shock is corrected. The kidneys act very freely during these few hours, while eliminating the excess of fluid, which necessitates more frequent catheterization of the bladder.

The patient should, of course, be kept warm, and the causes of shock should be removed as early as possible.

If shock develops *after* the operation from pain or other causes, the prompt use of intravenous saline, as above described, together with morphine or other indicated drugs, gives more favourable results than I have seen by any other method.

Some advantages of intravenous physiological saline are:

1. It may be given in large amounts without "reactions."
2. It is readily eliminated by the kidneys after it has accomplished its purpose of mobilizing the blood from stasis in the splanchnic area, and re-establishing circulatory balance.
3. It may be repeated without reaction.
4. It lowers the viscosity of the blood in shock.
5. It may be charged with oxygen and administered very rapidly if necessary.
6. It is available on short notice, which is its principal advantage over blood transfusion.

7. It is safer than blood transfusion in ordinary shock unless there has been a great hæmorrhage when whole blood is probably better if carefully typed.

Conclusions.

1. The anæsthetist should know the circulatory conditions of the patient at all times.

2. The pulse and blood pressure ratios are pre-requisites for the interpretation of the circulation.

3. Circulatory depression varies in intensity, as shown by the pulse-blood pressure ratios. Third degree is fatal in 69 per cent. of cases if untreated.

4. Most cases of surgical shock may be saved by the prompt intravenous administration of physiological saline in sufficient quantity to restore the systolic to within 10 per cent. of the patient's normal.

5. It is desirable and practicable for the anæsthetist to make a record of the pulse, respiration, blood pressures, etc., during the operation.

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Professor Dennis E. Jackson of the University of Cincinatti Medical College has been presented with a Scroll of Recognition by the National Anæsthesia Research Society for his extensive investigations in the pharmacology of anæsthetics.

In conjunction with, and at the suggestion of, Dr. F. H. McMechan, editor of "Current Researches in Anæsthesia and Analgesia," the *British Journal of Anæsthesia* will co-operate with The National Anæsthesia Research Society of the United States in providing a list of anæsthetists in the British Empire to be included in the next edition of the Directory of Anæsthetists published by that Society. This will make the directory international in character, and will thus cover the English speaking world.

CARDIAC MASSAGE.*

By A. G. Levy, M.D., M.R.C.P.,
Physician, City of London Hospital for Diseases of the Heart and Lungs.

I THINK I can explain the principles of cardiac massage without inflicting a long lecture, for it is *au fond* a simple enough matter.

Many of you remember in your early physiological training the scheme set up to represent the circulation,—rubber tubes to represent the arteries and a rubber ball with valves to represent the heart. By squeezing the ball fluid is made to circulate in the tubes. This is exactly the procedure in so-called cardiac massage. It is not massage at all in the ordinary sense of the word, but it is a rhythmic compression of the heart in such a manner as to cause the blood to circulate once more; in other words, an artificial circulation is set up. Now there are only three vascular areas which require consideration for our purpose, and I place them in order of urgency: (1) Pulmonary, supplied by the right ventricle; (2) central nervous, supplied by the left ventricle; (3) cardiac, supplied by the left ventricle through the coronary arteries.

(1) I place the pulmonary first because it is no good perfusing the tissues with blood unless that blood is oxygenated, and in order to oxygenate the blood the lungs must be ventilated with air. It is therefore essential to supplement our artificial circulation with an artificial respiration; and of methods of artificial respiration, I think the performance of perflation, or blowing air into the lungs through a tube inserted into the trachea through the larynx will be found most convenient. The ordinary Sylvester method is an alternative.

(2) A consideration of the central nervous system has a highly important bearing upon the ultimate success or failure of cardiac massage. The central nervous tissue is probably the most sensitive to loss of blood. We may take it that the

* Read before the Medico-Legal Society.

central nervous system, and especially the brain, will not stand cessation of the circulation for a longer period than five minutes without risk of serious damage. The centres in the bulb and spinal cord will survive longer, but if the restoration of circulation be delayed beyond five minutes, even though the circulatory and respiratory functions be efficiently restored, severe cerebral symptoms are likely to occur which seriously jeopardize the recovery of the patient. The symptoms are mainly delirium and muscular spasm or coma, with incontinence of urine and fæces, to which the patient generally succumbs. A case has been reported in which the artificial circulation was only set up $13\frac{1}{2}$ minutes after syncope, and in which the patient recovered completely after fourteen days of severe cerebral symptoms; this is a unique case, but it shows that the performance of massage is not altogether hopeless even after a considerably longer period than five minutes.

(3) I consider the coronary circulation last, because the heart possesses an extraordinary attribute of retaining its excitability, even after prolonged anæmia, and not only so, but the automatic mechanism which governs the rhythm and sequence of the heart is readily restored. This has been proved many times in many ways, both in the intact animal and in the excised heart perfused with a suitable fluid. As regards man, there is on record a case in which the heart of a man was made to beat, feebly it is true, twenty-four hours after he had been executed by hanging.

It will be evident to you that it is no use attempting to restore a heart which is incapable of functioning. If the heart fails, for instance, from a non-volatile toxin either manufactured within the body or introduced into the circulation, it is obvious that massage is useless; massage will not get rid of the poison. So also it is useless to restore the heart when the failure is secondary to the permanent failure of other organs, as in severe shock (where the primary lesion is vascular), or in any condition in which other vital functions are seriously affected.

Cardiac massage is, in fact, in practice confined to certain cases of heart failure which take place upon the operation table, when all facilities are available for its prompt applica-

tion. Such cases, I think, come mainly under three headings, viz., asphyxia, extreme overdose with a volatile anæsthetic, and chloroform syncope. In the case of asphyxia the heart stops from want of oxygen; if it has not completely stopped then artificial respiration alone will supply this want, but after complete arrest cardiac massage in addition is the only hope; it is completely successful in experiments upon animals. So also in the case of an overdose of a volatile poison, such as ether or chloroform used as an anæsthetic; the breathing ceases before the heart is finally arrested, and here again the primary necessity is oxygen, which artificial respiration will supply; but if the signs of over-dosage are disregarded then the heart will stop completely, and an artificial circulation must be set up by massage; in my series of twelve experiments upon cats, overdosed with chloroform to complete arrest of the heart, massage was in every case successful. Artificial respiration alone is successful in the vast majority of instances of over-dosage, but it is conceivable that cardiac massage may be required in rare instances in which the evidence of overdosage has not been promptly recognized.

It should be noted that a volatile poison such as chloroform is excreted through the lungs when the circulation through these organs is restored, and so the body is relieved of the overdosage, but cardiac massage would be entirely ineffective in the case of a non-volatile anæsthetic such as hedonal, just as it is ineffective in connection with an autogenous toxin.

The main use of cardiac massage has been its application in cases of "chloroform syncope." This is a sudden and distinctive form of heart failure, unconnected with overdosage; the heart fails because the ventricles pass into a condition known as fibrillation, when they become absolutely incapable of propelling blood through the arteries. There is always a chance of spontaneous recovery from this condition, but after the lapse of two minutes there is no other hope of recovery except by cardiac massage; there is no other remedy; artificial respiration alone is useless. The way in which massage acts in this condition is as follows: The ventricles have a natural tendency to escape from fibrillation whilst their tissues are supplied with properly aerated blood, and massage, by maintaining the coronary circulation, affords a prolonged

opportunity for the exercise of this tendency. As a fact, in my series of 29 experiments on cats a successful result was obtained in every case. The duration of the massage before recovery occurred varied from less than a minute up to a maximum of 48 minutes.* In dogs the results are not nearly so satisfactory, but there is good reason to believe that the human heart resembles the cat's heart in respect of its susceptibility to recovery,† and that therefore the results should be good when a proper technique is observed.

As regards technique, it is obvious the heart must be properly grasped and squeezed, both right and left ventricles, and this can be done most effectually by passing the hand into the left pleural cavity through an incision made in the attachment of the diaphragm to the left costal margin. Attempts at compressing the heart from below the diaphragm are mere waste of time, although a few such attempts have been successful. This effective compression of the heart is the main pivot upon which success or failure turns; but success cannot be expected unless an effective artificial respiration is also maintained throughout, a point, I am afraid, which has been too often neglected. I read an account recently of a "surgical miracle" . . . An operation for enlarged tonsils terminating in chloroform syncope. The surgeon opened the abdomen and massaged the heart under the diaphragm. After this had been going on for ten minutes he perforated the diaphragm and performed direct massage. After a further ten minutes the heart beat normally, but the patient never recovered consciousness. The "miracle" would have been better worth recording if valuable time had not been wasted doing subdiaphragmatic massage. It is evident that direct massage applied within the five minutes time limit would have saved this patient. It was demonstrated that the heart could be restored, and with nerve centres undamaged by prolonged anæmia there would be no reason for non-survival.

In another case massage was commenced an hour and a half after syncope, and the heart resumed its beat, but the patient did not survive. This is merely playing with massage,

*When massage is prolonged, occasional short interruptions are beneficial.
†"Heart," 1920, vii, 175.

but I mention it to show how imperfectly the limitations of massage are appreciated even at the present time.

In another report of a fatality I find the doctor assured the coroner that every possible remedy was tried before resorting to massage. In this way we cannot look for success. If massage is done at all it must be done promptly and effectively. The recorded complete successes are not many in number, but I am convinced there should be many more. No doubt we cannot look for the same results in man in the operating theatre that we get in cats in the laboratory. The conditions are somewhat different, but the principles are the same, and only require proper application.

Let me now briefly repeat the main factors of success.

(1) Massage should be commenced within five minutes of the onset of syncope—this in the interest of the nerve centres.

(2) Heart compression, to be effective, should be performed by the hand in the left pleural cavity, and the right ventricle compressed as well as the left.

(3) An effective artificial respiration must be maintained throughout.

(4) Any cardiac poison present must be a volatile one. The heart must be capable of functioning, and all the other vital organs must be in working order.

In conclusion, I may remark upon the public interest which has been taken in this revival of the apparently dead. It becomes difficult to draw a line between life and death, or to give an exact definition of death; perhaps we may say that real death is death of the tissues, but this is a matter I prefer to leave you to consider and decide to your individual satisfaction, or, it may be, to your dissatisfaction.

At the March 18th meeting of the Royal Society of Medicine, when a discussion took place on The Possible Substitutes for Cocaine, Dr. H. H. Dale, who opened the discussion, stated that he had private information of a new local anæsthetic which had been produced in Germany.

Dr. A. L. Flemming has been appointed Lecturer of Anæsthesia at the Bristol University, and Mr. S. R. Wilson has been named in a similar capacity at the Manchester University.

EDITORIAL.

WITH this number the *British Journal of Anæsthesia* completes the First Volume of its existence, thus reaching Milestone Number One along a road which hitherto was new and untried.

When the idea of a medical periodical of this sort was first broached it was realized that there were many questions to be answered satisfactorily before plans could be safely undertaken to put the project into execution. There was little doubt as to the desirability of such an undertaking, but could sufficient support be obtained in so restricted a field; and, further, would it be possible to secure enough high grade contributions to fill a moderately large number of pages every quarter?

These questions have answered themselves in so far as Volume One is concerned. As regards the future we should like to point out that it is very much in the hands of anæsthetists generally. We take it that it is now felt to be a matter of some importance that our specialty continue to possess an organ of its own to act as its mouthpiece, as well as to assemble and present, at regular intervals, all that is instructive and of pertinent interest. Also, that it is desirable to be able to record the results of research workers abroad alongside those of our own.

These functions have all been attempted in the present volume, with what measure of success it is not for us to say.

There is this to be emphasized. Our pages are by no means restricted to certain writers or contributors, but, on the contrary, are open to all and sundry, for the publication of ideas or facts of value or interest. A glance at our quarterly bibliography will be remindful of the enormous amount, as well as great variety, of work being done in many quarters, and this should suggest new fields for research and investigation.

We desire to be more than a mere recorder of ideas. It is hoped that by placing the world of anæsthesia before anæsthetists generally it will aid in considerable measure to encourage research and investigation on the part of many who,

for the lack of such a mirror, would fail, as it were, to see the reflection of the many possibilities.

We repeat that our pages are open to every type of worker, but we are particularly anxious to encourage those who are standing on the threshold and hesitate to make a beginning. It is realized that, if the specialty of anæsthesia is to assume the status it deserves, it will be necessary to add a constantly increasing number of recruits to the already honourable list of those at present in the field. EDITOR.

Rectal Administration of Ether.

During the late war, and after, I have been in the habit of giving rectal ether in suitable cases. The cases in which I have given this were one of breast amputation, gall-bladder cases, trephining, tongue and jaw cases, glands in neck, and amputations. Before one has recourse to rectal ether the state of the bowels must be closely gone into beforehand. Rectal ether must not be given to one who has loose bowels. I know this to my cost. I gave it to a case of Syme's amputation on a man who concealed from me the fact that he had some years ago suffered from amœbic dysentery. The rectal ether set up a recurrence of the malady, from which he died ten days later.

My *modus operandi* at the Liverpool Royal Infirmary is thus: The colon is thoroughly washed with a soap and water enema on the morning of the operation. It may take two or three washings out, and then a rectal tube is passed into the rectum, and, through a funnel fixed into the free end, the following fluid is poured in two hours before the time for operation: chloretone, gr. 5; ether and olei olivæ, of each ℥ii. The funnel is then removed, and the free end, clamped with a pair of forceps, is left in the rectum. Then, half an hour before the operation, a hypodermic of atropine sulphate, gr. 1/100, and morphia tartrate, gr. $\frac{1}{6}$, is given. Then, twenty minutes before operation, the following mixture is poured into the rectal tube through the funnel, which has again been inserted into the free end: ether, 4 ozs., olei olivæ, 2 ozs. This must be poured in not faster than 1 oz. per minute. Sometimes the patient forces it out, but a few whiffs of chloroform stops this. The patient must not be moved on to the table until the ether

has taken effect, which generally is in twenty minutes. The rectal tube is left in the rectum and the funnel removed; the free end clamped with forceps, and if there should be any signs of collapse during the operation the forceps are removed, and the rectal tube allowed to empty itself, but I have seldom occasion to do this. The after treatment is simple. The solution is drawn off by the rectal tube, and the bowel irrigated by a soap and water enema, and this should be followed by an injection of 5 ozs. of olive oil.

The advantages of rectal ether in mouth and trephining cases are supreme, as the anæsthetist is completely out of the way of the operator. ARTHUR JOSEPH O'LEARY.

ANÆSTHESIA FOR DRESSING WOUNDS AFTER OPERATION, AND ESPECIALLY FOR REMOVAL OF GAUZE PACKING.

My attention has for a long time past been attracted to the immediate suffering and after-shock caused to patients by the withdrawal without an anæsthetic of gauze packing with which wounds or cavities have been tightly plugged at the time of operation. The withdrawal generally takes place a few days after this event, and at a time when the patient is feeling better in himself and is gaining in confidence. The pain of the slow dragging of the gauze over the sore surface is intense, and the shock correspondingly great, insomuch that the patient may groan and sweat, and is not uncommonly "shocked for the rest of the day." I have heard the patient so describe the condition, and say that he will never forget it. Why should he ever have cause to remember the occasion when, by administering a little "gas" or other anæsthetic for a minute or two, the gauze or plug can be removed painlessly from some abdominal region or prostatic cavity or from nose or sinus? The prevention of this added shock to the patient avoids nervous and physical strain, which in itself is an important factor in the after care, and does not break continuity of confidence in the surgeon's future manipulations. Is it not well to think of the patient's point of view, and the possibility, nay the duty, of saving him cruel and needless pain after, as well as at the time of, operation?

W. J. MCCARDIE.

ABSTRACTS OF CURRENT ANÆSTHETIC LITERATURE.

Current Researches in Anæsthesia and Analgesia, Feb., 1924.

Anæmia in relation to surgery and anæsthesia. Wm. H. Gilbert.

Some effects of narcotics on spirogyra. Prof. Francis E. Lloyd, Dept. of Botany, McGill University, Montreal.

Clinical scope and utility of carbon dioxid filtration in inhalation anæsthesia. R. M. Waters.

Obstetric shock. A. H. Miller.

The value of nirtous oxid-oxygen anæsthesia in oral surgical operations. Sterling V. Mead.

Observations on general and local anæsthesia in face and jaw surgery. Archibald L. Miller.

Myocardial deficiency from an anæsthetic standpoint. J. L. Yates.

Anæsthesia Supplement, *American Journal of Surgery*, January, 1924.

Observations on 900 cases of intravenous anæsthesia. A. Lehrnbecher, Nurnberg, Germany.

*Ethylene as a general anæsthetic. W. Easson Brown.

*The use of atropin as a preventive of respiratory sequelæ. Mary A. Leavitt.

*Psychology in anæsthesia. John T. Buettner.

The goitre risk and a simplified technique of local anæsthesia. John Hunt.

Keeping anæsthetic records and what they show. John S. Lundy.

Ethylene as a general anæsthetic.

In this paper Brown of Toronto reports his experiments with the use of gas on animals. He found that a mixture of 80 per cent. ethylene and 20 per cent. oxygen depressed the animal and caused it to lie on its side. Respiration at first was slightly quicker but soon became normal. He anæsthetised mice, rats, guinea-pigs and small rabbits, and cats and dogs were narcotized for periods as long as two hours.

Considerable time was spent in endeavouring to discover if ethylene might, without warning, terminate fatally, and it was found that poisonous doses were always shown by a slowing and falling respiration, thus giving ample time for a lessening of the concentration by adding oxygen.

Ethylene gas is now placed extensively on the market in America, and many of the manufacturers of anæsthetic apparatus advertise its use in connection with their machines.

The use of atropin as a preventive of respiratory sequelæ.

Dr. Leavitt gives an outline of the work along this line conducted at a large general hospital in Boston for the past two years in an endeavour to eliminate respiratory sequelæ following operations. She reports several hundred cases with but one instance of post-operative pneumonia. Every possible effort is made to operate only in cases free from respiratory symptoms, but this failing, the following procedure is carried out :—

A hypo. of $\frac{1}{4}$ gr. morphin and $\frac{1}{150}$ gr. atropin is given an hour before operation; the patient is put under with gas-oxygen-ether sequence and kept under ether as lightly as possible compatible with the work to be done; another $\frac{1}{150}$ gr. of atropin is given at the close of the operation, and this dose is repeated every four to six hours for 48 hours, if the patient can stand it, that is, if the dryness caused is not too pronounced.

With the exception of the case of pneumonia mentioned the only respiratory sequelæ met with were very mild and of short duration.

Psychology in anæsthesia.

Buettner re-states the case for giving sufficient consideration to the mental side of patients while administering the anæsthetic. He well points out the importance of allaying fear in the patient's mind, and urges tact and gentleness in dealing with timid cases and especially children. He emphasizes the need for quiet during and immediately following anæsthesia.

California State Journal of Medicine, San Francisco, Jan., 1924.

Effects of posture on relaxation under anæsthesia. C. B. Palmer.

Palmer has gone into this matter very extensively and, as a result of observation in something like 10,000 cases, he concludes that, if proper attention is paid to the posture of the patient during induction and maintenance of anæsthesia, better relaxation and smoother anæsthesia will be obtained. He further asserts that the post-operative discomfort will be less.

Johns Hopkins Hospital Bulletin, Feb., 1924.

A chemical study of a case of chloroform poisoning. H. J. Stander.

Stander states that since 1894 there have been three other cases at the clinic, and of these two were fatal, both showing typical central necrosis of the liver. The first symptoms of poisoning in all cases were nausea and vomiting 18 to 24 hours after the administration of

the anæsthetic, following which jaundice set in, then drowsiness and coma; or first the patient was irrational, violent and later comatose. The heart functioned fairly normally. The liver was large and tender in all cases, and there was a leukocytosis of about 20,000. In the three fatal cases death ensued from two to six days after the anæsthetic.

The treatment in the non-fatal case was calcium lactate gr. xv every two hours, and later 5 per cent. glucose solution by the Murphy method, 2,500 cc. of this solution having been administered.

He concludes with the belief, as a result of the study of these cases, taken in conjunction with the work of Opie, Whipple, and others, that a diet rich in carbohydrates and milk, and restricted in fats, is advisable before chloroform anæsthesia.

Monatsschrift für Geb. und Gynäkologie, Berlin, Nov. 1923.

Prevention of chloroform syncope. STRUBE.

Strube advocates spraying the nose with a preliminary 1-5 per cent. cocain spray as a routine in general surgery wherever chloroform is to be used. He thinks that chloroform syncope may be prevented thus by allaying nasal irritation caused by this anæsthetic.

Policlinico, Rome, Dec. 15, 1923.

Spinal anæsthesia and retention of urine. I. DI PACE.

Di Pace calls attention to a case of retention of urine following spinal anæsthesia. The retention lasted two weeks. He attributed this condition to injury, by the needle, of the sacral nerve.

Chugwai Iji Shimpo, Tokio, July, 1923.

Cerebrospinal fluid after chloroform. SHYOSHIRO OHI.

The author made chemical examinations of cerebrospinal fluid after chloroform anæsthesia, and reports finding a remarkable increase of the H-ion concentration. This same increase he discovered following a death from same.

Journal of the American Medical Association, Chicago, Feb. 9, 1924.

Ethylene and oxygen as an anæsthetic for infants. JOHN D. LUNDY.

He reports four cases in which he found the respiratory rate curve of each patient to be radically different from that of other patients. He does not think nitrous oxide has been as satisfactory in his hands, as ethylene for abdominal work in infants, especially if the patient

is not a good risk. He concludes that in the administration of gas anæsthesia for infants it is urgently necessary to watch the colour, listen to the respiration, palpate the pulse, and measure the blood pressure; and he believes that in using ethylene in all types of risks, both young and old, it is in the weak patient and the bad risk that the advantages are best demonstrated.

Archives of Surgery, March, 1924.

Studies in exhaustion: vi. *Septicæmia.* G. W. Crile.

This article is one of a series of papers in which Crile sets out experimentally to demonstrate his hypothesis that "an animal or a man who has first been exhausted by exertion, emotion, hæmorrhage, asphyxia, anæsthesia or loss of sleep succumbs more readily to infection, and an animal or a man exhausted by infection succumbs" to the conditions named more readily. He, therefore, thinks it important to discover whether the exhaustion due to infection differs from the exhaustion from emotion, exertion, etc., etc.

In the case of ether and nitrous oxide, diphtheria toxin was administered to four animals under full ether anæsthesia, and one under full nitrous oxide anæsthesia. In each case the animal was killed after the anæsthesia had been continued for four hours, and he concluded that, as a result of his examinations of the brain, liver and suprarenals, continuous ether and nitrous oxide anæsthesia diminish the histologic changes produced by a toxin. Excellent illustrative photomicrographic reductions accompany the article.

La Presse Médicale, Feb. 13, 1924.

Anæsthesia with ethylene. By E. Papin and L. Ambar

The ideal anæsthetic does not yet seem to have been found, the potent ones being relatively dangerous and the safe ones not sufficiently powerful. Ether and chloroform offer many advantages, for owing to the potency they enable even the most difficult subjects to be anæsthetised, and they provide a relaxation which will satisfy even the most exacting surgeon; they are responsible, however, for occasional immediate and more frequent remote complications. Nitrous oxide, on the other hand, is practically innocuous, but it is a weak anæsthetic in so far as, in the absence of reinforcement with such drugs as morphia and hyoscine, it is apt to give but poor relaxation; deep narcosis with this gas is associated with asphyxia more often than administrators realise, the common result being an initial rise and a subsequent fall of blood pressure with various degrees of nausea, vomiting, and general depression. Being dissatisfied, then, with the reagents at our disposal we determined to try ethylene

because experiments performed on dogs by Schafer, Breton, and one of us proved that it was more powerful than nitrous oxide. As regards administration we found it closely resembled nitrous oxide and that it was essential to be able to vary the proportion of oxygen at any moment. Our technique was as follows : The gas bag being filled with ethylene, the patient was allowed to breathe for a minute or so and the bag was then emptied to remove the carbon dioxide of respiration, and again filled with ethylene and just enough oxygen to prevent cyanosis ; after five or six minutes sleep supervened ; after this stage was reached we added oxygen only in sufficient quantities to obviate asphyxia, and ethylene only when the patient tended to come round.

The course of anæsthesia was as follows : After two or three minutes there was a stage of excitement with incoherent conversation, followed by a repetition first of phrases, then of words, and finally of syllables ; after from five to ten minutes analgesia and muscle-calm were established and certain operations could be performed, but perfect anæsthesia with complete relaxation was not established before from 15 to 20 minutes. Arterial tension was not affected, and the patients' colour remained normal.

As to sequelæ they were very slight ; vomiting occurred once only in 58 cases, and there was no suggestion of pulmonary or renal trouble. A. L. Flemming.

Revue de Chirurgie, No. 2, 1924.

Epidural anæsthesia. By Pierre Mocquot.

This form of anæsthesia, although invented and practised in France in 1901 by Sicard and Cathelin, is now seldom used in that country, but the author, after some months' experience of it, is of opinion that it is of distinct value in certain directions.

Cathelin's first attempts were made with cocaine and failed because the analgesia obtained was not sufficiently complete, and Chepault obtained results which were too variable to be considered satisfactory. In 1909 Stoeckel, in Germany, found that with novocaine and adrenalin, in parturition, pain was abolished without interference with uterine contractions, and that delivery could be rendered almost imperceptible. In 1910 Laewen insisted that for success with this method it was important to employ a comparatively large dose of the drug, as regards both strength and quantity, and to limit its use to " low " operations, Schlimpert having had as many as seven complete failures in a series of 93 " high " anæsthesias. Following Germany, America took up the method and employ it to a considerable extent at the present time, and it seems probable that the discredit into which it has fallen may be justifiable as regards the high type but not as regards the low variety.

In 54 cases Mocquot and his co-workers met with four complete failures, three incomplete analgesias, and 47 successes, in which they

were able to operate upon the anus, the lower rectum, the vulva, vagina, and perineum, and upon the male genital organs.

Various complications have been reported such as collapse, vomiting, headache, etc., and a certain number of fatalities have occurred. From Germany, Freusberg reports 10 deaths in 4,200 cases of epidural anæsthesia, in 3,450 of which novocaine was the drug used. At least three of these 10 deaths were directly due to the anæsthetic, and in two of them the dura was punctured, being abnormally low. In some of the 10 cases where death occurred the quantity of novocaine exhibited was large, being as much as 80 or 90 cg. Eymer reports a case of a robust woman who was operated on for an ovarian cyst, and in whom death from heart failure took place quite suddenly 10 minutes after the operation had commenced. She was 27 years old, and at the post mortem examination no cause of death was revealed. Eymer's practice is to use large doses of novocaine and repeated hypnotics.

According to Wiedopf death is generally attributable to (1) Intravenous injection; (2) too large a dose of novocaine, especially in feeble subjects already under the influence of hypnotics; or (3) wounding the dura.

Mocquot recommends a 2 per cent. solution of novocaine of which 15 to 20 cm. or 30 to 40 cg. of the drug is sufficient for an adult. His formula is: Novocaine 60 cg., Sod. Bic. 15 cg., Sod. Chlor. 10 cg., Water to 30 cm.; 6 or 7 drops of 1 in 1000 sol. of adrenalin being added. A. L. FLEMMING.

Deutsche Zeitschrift für Chirurgie, Leipzig, Nov., 1923.

Late chloroform injuries. J. VORSCHUTZ.

Vorchütz states that in these cases a few days after the operation, which was regarded as successful, there was a slight rise of temperature and restlessness accompanied by slight jaundice and albuminuria. Then come delirium and coma. Forty-eight of his 57 cases were abdominal operations, and he thinks that the chloroform injury was due to the toxic action of the chloroform on the solar ganglion. Extensive experiments which he conducted on rabbits and dogs bear out his contention that chloroform is particularly dangerous in all abdominal conditions, as well as for the type of nervous patients. He regards the slightest derangement of the liver or kidneys as especially contraindicative of the use of chloroform or any mixture of chloroform. Drugs which induce sweating and diarrhœa form a logical treatment, and thus pilocarpin is suggested.

The report of Stander, of Johns Hopkins (abstracted in this number), notes a somewhat similar set of symptoms in his cases.

Münchener Medizinische Wochenshrift, Munich, Jan. 11, 1924.

Glucose injections and ether anæsthesia. KUTSCHA-LISSBERG.

Kutscha-Lissberg injected 10 cc. of a 50 per cent. solution of glucose intravenously, and 0.01 gm. morphine subcutaneously from

six to twelve hours before an ether anæsthesia. He mentions that even in alcoholics there was no excitement. Less ether is used. Unfortunately, in the 100 cases reported, there were 11 pneumonias and 13 per cent. of bronchitis. He thinks bad weather and poor heating were responsible for these results.

The Canadian Medical Association Journal, Oct., 1923.

The effects of ether anæsthesia on afferent paths in decerebrate animals. Alexander Forbes and Richard H. Miller.

From the laboratories of physiology of the Harvard Medical School.

These two investigators set out to determine whether the contention of Crile and Lower " that ether anæsthesia offers no protection to the brain cells against the effect of trauma " was correct.

At Dr. Cannon's suggestion they recorded galvanometrically the action currents in the afferent nerve paths in the decerebrate animal. In such a preparation operative procedures and stimulation of sensory nerves may be performed with or without ether without causing pain.

The transection is performed through the mid-brain and the main afferent paths to the brain reach the cut surface in the mesial fillet. A large peripheral afferent nerve is stimulated and the electrical disturbances in the fillet are recorded with a string galvanometer, connected up with the exposed end of the severed brain stem.

The experiment was performed first without ether and then repeated under deep surgical anæsthesia.

The typical response obtained from the galvanometer without general anæsthesia was a double one—a slight initial excursion which represents the arrival of the impulses in the medulla, and a later large excursion due to the passage of the impulses along the fillet. The administration of ether reduced or abolished the second response. The decrease was appreciable even before the corneal and flexion reflexes disappeared, and there is usually complete disappearance of the response before the pinna reflex vanishes. The effect cannot be on the nerve fibres themselves and it would appear that Sherrington's view that the ether acts on the synapses is correct.

It would seem that under deep anæsthesia very few of the central neurones receive impulses on peripheral stimulation, and that ether is effective in protecting the brain against damage by sensory impulses. The authors similarly investigated the effect of magnesium chloride in producing general anæsthesia and of calcium chloride in neutralising its action.

Their early work in this direction would suggest that magnesium chloride is a dangerous and unsatisfactory anæsthetic, and is apt to cause sudden paralysis of respiration. Further it is not as effective as ether in reducing afferent stimuli. It seems to act more on the motor than the sensory side.

If calcium chloride is injected before respiratory failure is complete the animal is rapidly restored. S. R. Wilson.

SOCIETY REPORTS.

ANÆSTHETIC SECTION OF THE ROYAL SOCIETY OF MEDICINE, March 7th, 1924.

Professor Storrm van Leeuwen, of Leyden, read a paper On The Anæsthetic Properties of Purest Ether. He first became interested in the subject right after the war as a result of rumours which were prevalent that the narcotic effect of ether was due to impurities present rather than to the action of the ether itself. Manufacturers had directed their efforts towards producing an ether that should be as chemically pure as possible, and, as a result of these reports, a number of them had approached him with the request to go into the matter in an experimental way, and to inquire into the facts. He obtained, in the open market, a number of samples which, upon examination, were found to differ only slightly in their composition, and he also discovered that none was absolutely chemically pure. He then set about preparing an ether that would fulfil, as far as possible, the requirements of a pure ether. He then learned that the non-narcotic action of pure ether was found not to be proved. Further experiments with chemically pure ether and the commercial brands developed the fact that the same effects were produced narcotically with both types.

He then directed his attention to the impurities found in commercial ethers. Methyl ethyl ketone, if given alone, is much more toxic than if given with ether, and if ketones were present less ether was required for narcosis. Certain other impurities were irritating and unsuitable for narcosis. In some commercial ethers peroxides were formed after exposure for some time in direct sunlight. Among those found to be free from peroxides were Cotton-process ether and Ethanesal, as well as the ether prepared by crystallization. Upon mixing pure ether with benzidene no peroxides were formed, and Professor van Leeuwen suggested that in order to stabilize ether a small amount of some other substance should be added. He concluded that pure ether differed in no way from ordinary commercial ethers as regards narcotic action.

Dr. R. L. Mackenzie Wallis said that although he had believed that pure ether was the ideal anæsthetic he found that the purer the ether the less anæsthetic effect it produced.

Dr. E. Langton Hewer agreed that this was so in clinical practice. He had experimented with different samples without having previous knowledge as to which was the pure one, and he had found that best results were obtained from a pure ether to which ketones had been added. As regards the chemical composition of the substance eventually known as Ethanesal, Mr. Chaston Chapman investigated a sample purchased in the open market and found it to

contain only slight traces of peroxides, the chief impurities being ketones, which were present to the extent of 1.3 per cent.

Dr. Charles Hadfield stated that as he had read three different accounts of the formula of ethanesal he should like to know its exact composition.

Professor Finnemore stated that experiments which he had made some seventeen years ago on the purification of ether proved that pure ether was very unstable, but that it was made much more stable by the addition of a small quantity of alcohol. He added that the question of the testing of ether should be taken up and that standards required should be formulated by the Society. The Government should be urged to permit the manufacture of ether from pure ethyl alcohol without the financial penalties now in vogue.

Mr. H. E. G. Boyle, by means of a chart showing an analysis of 10,000 cases of anæsthesia with ethanesal alone or with the addition of other anæsthetics, demonstrated that the results obtained compared favourably with other ethers.

Dr. F. E. Shipway invited attention to recent American claims that pure ether was a perfect anæsthetic.

At the meeting of the London Association of the Medical Women's Federation on March 11th, there was a general discussion on anæsthesia.

Dr. H. N. Payne said she preferred ether to chloroform on grounds of easy administration and safety. She thought patients preferred gas, and she induced with this and followed up with closed ether. For toothless patients in the Trendelenberg position, in the late stages of long operations and in thyroid cases, she preferred the open method.

Mrs. A. Gilliatt preferred induction with chloroform or C.E. mixtures for nose and throat operations.

Mrs. Margaret Bredy demonstrated the Looseley apparatus for the use of closed ethyl chloride. She thought this was a useful halfway house between nitrous oxide and chloroform. The most important signs to watch were changes in respiration, as well as alteration of colour, especially to a waxy pale colour. Ethyl chloride, having a cumulative effect, it was unwise to push its administration till the pupil was fixed, central and dilated. She strongly advised against the administration of a second dose during the same operation as she knew of a fatality which, she believed, was caused in this manner.

Mrs. Tindal-Robertson, discussing spinal anæsthesia, said that the injection of stovaine was liable to cause a drop of blood pressure which might cause trouble in a patient badly shocked before operation. On the contrary, if no shock was present to begin with, spinal anæsthesia actually diminished shock.

Dr. Enid Moore advised slow induction in administering gas and

oxygen. Statistics at the Infants Hospital, where gas and oxygen was used exclusively for abdominal operations, showed fewer fatalities than where other methods were in vogue.

DEATH UNDER NITROUS OXIDE AND OXYGEN.

R. C., aged 72. Dec. 5, 1923. Fractured neck of left femur. Anæsthetic given for reduction of displacement and putting up in plaster of Paris.

In view of his age and the house surgeon's statement that he was "a bit chesty" gas and oxygen was given.

During induction there was a short cough at each expiration. The anæsthetic lasted 20 minutes. He was somewhat cyanosed in spite of having 50 per cent. of oxygen. Towards the end the breathing became shallow, the colour bad and the pulse feeble. The mask was removed but the condition got worse and the patient died on the table two or three minutes after the anæsthetic was stopped.

Post-mortem the lungs were slightly œdematous. Larger bronchi had rather thickened walls but did not contain any exudate. Tracheo bronchial glands were anthracotic. Pericardium covered by considerable layer of fat. Epicardial fat also increased. Heart not enlarged, muscle somewhat flabby but no myocardial lesion. Coronary arteries healthy. Mitral and aortic valves normal. Kidneys normal. Liver rather small (40 oz.). Spleen large and flabby. On section Malpighian bodies greatly hypertrophied.

The death was most unexpected as the patient's condition beforehand did not appear to be bad. The cyanosis noticed during anæsthesia was only slight. In an ordinary case of ether anæsthesia it would have passed almost without comment, and is only mentioned here because of the fatal result, and also because it was in marked contrast to the usual rose pink colour of patients under gas and oxygen. Asphyxia was certainly not the cause of death. The interesting question is: Why did the heart fail? Was it anything to do with the anæsthetic, was it fat embolism due to movement of the broken bone, or was it the cardiac inhibition of the medico-legal experts?

I should very much like to hear of any other similar cases, and other people's opinions as to the degree of responsibility of the anæsthetic in causing death. Theoretically I suppose gas alone cannot kill a patient except by asphyxia, and since with the addition of oxygen this danger is removed, it ought to be, and is claimed to be, the very safest of all anæsthetics. But when a case like this comes under one's personal notice it makes one wish to hear other opinions, as the question of allocating the responsibility of causing death to the anæsthetic or the operation is so difficult.

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Some Recent Deaths under Anæsthesia. Cuthbert Hall. *Medical Journal of Australia,* Feb. 16, 1924.

Synergistic Anæsthesia and Analgesia in Surgery. J. T. Gwathmey and G. Schwartz. *Medical Journal and Record,* New York, Jan. 16, 1924.

BOOK REVIEWS.

"Local Anæsthesia." Prof. Dr. Heinrich Braun. Henry Kimpton, 1924. 25/- net.

This is the second American, from the sixth German, edition, and is the translation of Dr. Malcolm L. Harris of Chicago. Since the original work appeared in 1905, writers on local anæsthesia have drawn largely from its pages, and with each succeeding edition Professor Braun's book has been more and more accepted as a great classic. Every phase of the subject is thoroughly elaborated, and practitioners of this form of anæsthesia will find therein the fullest particulars as to the various methods in vogue.

The breadth of the field is now practically unlimited. At Braun's clinic the proportion of operations of all types performed under local anæsthesia exceeds 50 per cent., and even this is surpassed in Dallinger's wards, where the proportion is said to be as high as 94 per cent.

These represent every type of case. Not more than a cursory reading of this work is needed to remind one that for the application of local anæsthesia much more than a mere acquaintanceship of the technique of injection is required. As Braun well puts it, it is necessary to possess a comprehensive knowledge of the sensory innervation of the operative field, and the subject must be taken up fully, the technique for each operation being studied in detail.

The work is replete with photographs, illustrations and drawings of the various methods as applied to all the principal operations, thus making the accompanying text clearer and easier to follow, and each chapter includes the necessary description of the sensory innervation concerned.

An interesting development of local anæsthesia is its application

to simple fractures and luxations. The author gives a list of 51 cases in which he applied this procedure. In only one case—a fracture of the tibia—did it prove unsuccessful.

This work should be a part of the book armamentarium of every anæsthetist. Not that he will be necessarily persuaded by it to forsake general anæsthesia, but, certainly, he should know something of alternative methods to resort to when occasion demands. He should also have a fair knowledge of the chemistry of the various agents available. Braun's book gives all this thoroughly.

" Anæsthesia in Dental Surgery." T. D. Luke, M.D., F.R.C.S. (Ed.), and J. Stuart Ross, M.B., F.R.C.S. (Ed.). Wm. Heinemann, Ltd. Fifth edition. 10/6.

The success of this work has called for another edition, which thus brings the teaching and practice of dental anæsthetics up to date. The death of Thomas Davy Luke placed the sole responsibility for preparing the present volume upon Dr. Ross, who is to be congratulated on maintaining the high standard set by previous efforts.

After reviewing briefly the history of anæsthesia details are given in relation to the choice of anæsthetics for dental operations, and the author rightly emphasizes the danger in the employment of chloroform for routine use. A chapter is devoted to the law in relation to anæsthetics, and stress is laid upon the need for systematic training in dental anæsthesia. The author is correct in insisting that no one, be he doctor or dentist, is a safe anæsthetist who has not given serious attention to the subject, and who has not devoted extra study to it above that required for surgical anæsthesia.

The dental student or practitioner will find the book all that he requires for his special field, while the medical practitioner will find in it just that information which will help him to adapt his knowledge of surgical anæsthetics to the requirements of dental work.

" Nitrous Oxide-Oxygen Analgesia and Anæsthesia in Normal Labour and Operative Obstetrics." $ 2.50. National Anæsthesia Research Society, Lake Shore Road, Avon Lake, Ohio.

This is a tastily bound monograph published under the editorship of Dr. F. H. McMechan and the publication committee of the above-named society, for the benefit of all concerned in safer and more efficient obstetrics and anæsthesia. Every phase of anæsthesia in relation to obstetrics is covered, but especial attention is paid to the value of nitrous oxide-oxygen. A very good case is made out for resort to this combination in labour and in all obstetrical procedures, and both practitioner and anæsthetist will find the work valuable as a complete and up-to-date exposition of the views and practice of leading authorities.

The Society is to be congratulated on its initiative in bringing out a Monograph of this character, and one has no hesitation in commending it to all those interested in anæsthesia and analgesia in their relation to obstetrics.

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(Abbreviations: Orig. Art.=Original Article. Abs.=Abstract. Ed.=Editorial. B.R.=Book Review. Ill.=Illustrated. G.I.=General Items and Notes. S.R.=Society Reports. Dir.=Directory of Anæsthetic Societies.)

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